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MARCH 3, 1941
VOLUME 30, No. 5

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MARCH 3, 1941

VOLUME 30 NUMBER 5

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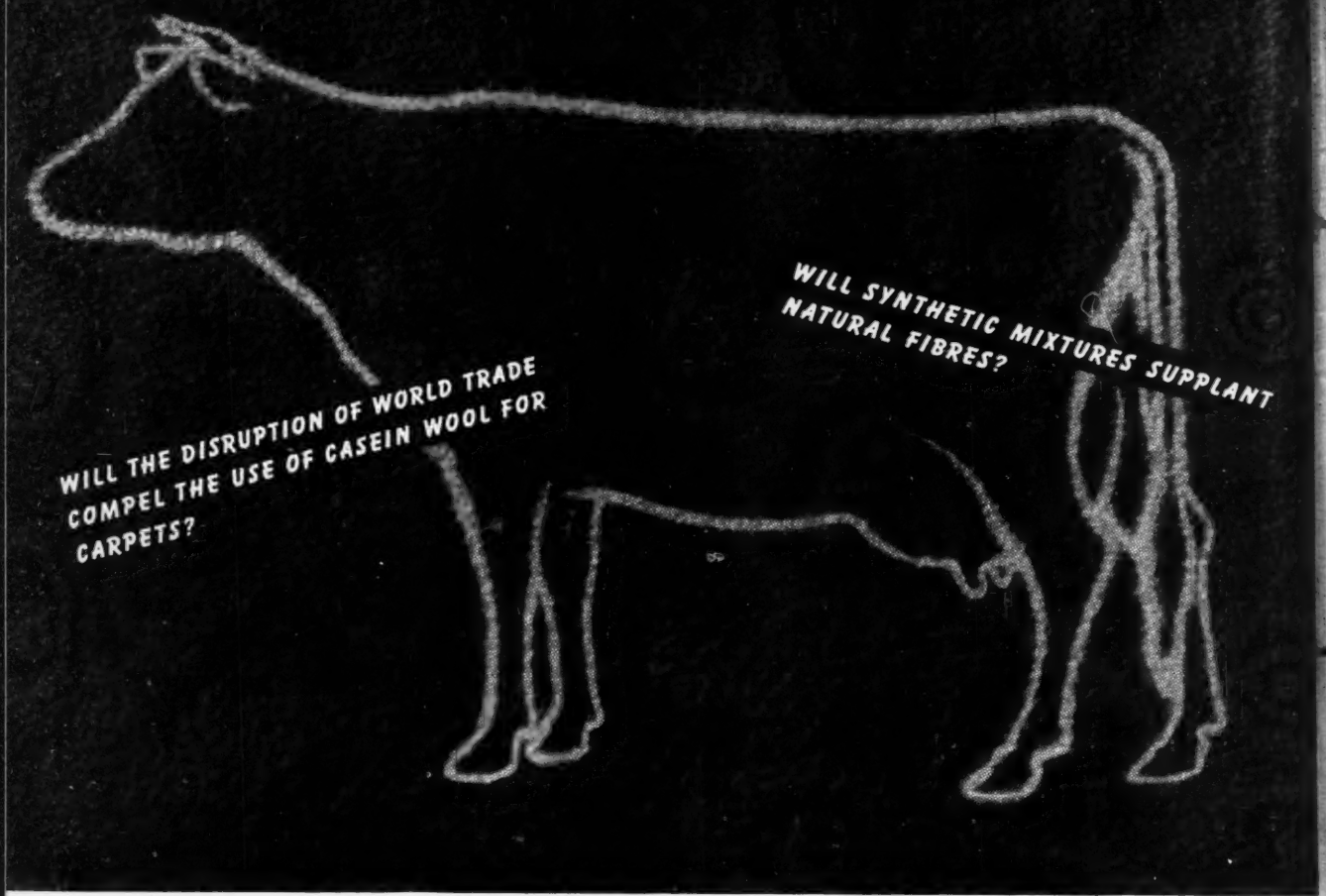
Will CARPETS *come from* COWS ?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DYESTUFF REPORTER

VOLUME 30 MARCH 3, 1941 NUMBER 5

BASE-COMBINING CAPACITY OF COTTON

ARNOLD M. SOOKNE and MILTON HARRIS*

ABSTRACT

It is well recognized that cellulosic materials contain acidic groups which bind ions and accordingly influence the electrical conductivity, the dyeing, and the finishing of the fibers or fabrics.

In an earlier investigation, the relationship between the ash content of cotton fibers and their acid-binding capacity was developed. To further study the acidic properties of cotton, the investigation has now been extended by Research Associates of the Textile Foundation at the National Bureau of Standards, to include the direct estimation of the acidic groups in the fiber by titration with alkali. Both monovalent and divalent cations were used in this work.

When dewaxed cotton is freed of its cationic ash electrodialytically, it binds a maximum of 0.065 milliequivalent per g of either silver or calcium ions, while depectinized cotton binds only 0.010 milliequivalent per g. These values confirm previous estimates of the carboxyl contents of these samples obtained by titration with acid. The identity of the base-binding capacities when mono- and divalent ions are used is a strong indication that the binding of these ions results from an acid-base reaction rather than from some undefined adsorption process. This conclusion was substantiated by esterifying the acidic groups of electrodialyzed depectinized cotton with diazomethane, which thus reduced the base-binding capacity to nearly zero. . . It is shown that the maximum silver-binding capacity can be obtained only by the use of the silver salt of a very weak acid. When the salt of a strong acid is used a sufficient number of hydrogen ions are in the solution to compete with the silver ions for the acidic groups of the fiber.

The silver-binding capacities of electrodialyzed dewaxed and electrodialyzed depectinized cotton are greater than those of dewaxed and depectinized samples, respectively. This result is explained in terms of competition of silver ions with the cations already on the acidic groups of the fiber.

The number of acidic groups in depectinized cotton is not altered by progressive treatment of the fiber with alkali, a fact which lends support to the tentative conclusion that the acidic groups in depectinized cotton are an integral part of the cellulose molecule.

I. INTRODUCTION

COTTON and other naturally occurring cellulosic materials bind acid by an exchange process in which the hydrogen ions of the acid replace the cations associated with acidic groups of the fiber[1, 2]. By application of this concept of ion-exchange to an investigation of the acidic properties of cotton it has been possible to allocate tentatively the acidic groups to the principal constituents of the fiber[2]. Thus, in mature cotton, most of these groups are part of the pectic substance; those not in the pectic substance are assumed to be part of the cellulose molecule. Considerable interest is attached to the latter assumption, especially since, if true, it might shed some light on the complex cellulose molecule.

In order to study further the acidic properties of cotton, our earlier work has now been extended to include the direct estimation of the acidic groups in the fiber by titration with base, using both monovalent and divalent cations.

II. EXPERIMENTAL PROCEDURE

1. Materials

All of the measurements were made on cotton from the same batch used in the earlier work[2]. The preparation of samples of "dewaxed cotton" by extracting raw cotton with alcohol and "depectinized cotton" by extracting dewaxed cotton with alkali has been described[2].

Some samples of dewaxed and of depectinized cotton were freed of their cationic ash by an electrodialytic procedure as follows. About 75 g. of cotton was wetted out with a 0.01 *M* solution of hydrochloric acid at room

*Research Associates at the National Bureau of Standards, representing the Textile Foundation.

temperature, and then electrodialyzed in a large cell until the conductance of the liquid in contact with the fiber approached that of distilled water. Quantitative determinations showed that the cationic ash of these samples was less than 0.004 M.-eq./g. (milliequivalent per gram). These samples will henceforth be referred to as "electrodialyzed dewaxed," or "electrodialyzed depectinized cotton."

All samples were conditioned at 21° C. and 65 per cent relative humidity before weighing. The moisture contents of the fibers were determined by drying representative samples at 105° C. for 2 hours in a vacuum oven.

2. Methods

Determination of the Silver-Binding Capacity.—Samples of cotton weighing about 5 g. and containing a known amount of moisture were immersed in 100-ml. portions of solutions of silver salts at 25° C. The amount of silver bound by the sample was determined by titration of 50-ml. aliquots of the original solution, and of the solution in equilibrium with the sample, using the Volhard method[3]. Preliminary measurements at several concentrations of silver ion indicated that equilibrium is attained in about 24 hours at 25° C.

The solution of silver *o*-nitrophenolate used in some of the measurements was prepared by adding an excess of silver oxide to a solution of *o*-nitrophenol at 70° C., and then filtering off the undissolved material. The silver *o*-nitrophenolate solutions were therefore saturated with respect to silver oxide.

Determination of Calcium-Binding Capacity. — The calcium-binding capacity was determined by the electrodialytic method previously described[4]. In the present investigation, however, a six-unit apparatus was used[5], and each of the determinations reported represents the mean of 4 determinations, corrected for 2 blanks.

Determination of pH.—pH values of the suspensions were measured with a McInnes and Belcher-type glass electrode and a vacuum-tube potentiometer, using a cathode-ray tube as null indicator. The pH values were referred to potassium acid phthalate, 0.05 *M*, to which was assigned a pH value of 4.01[6].

Temperature.—The solutions of silver salts in contact with the fiber were kept at 25° ± .02° C.

III. RESULTS AND DISCUSSION

1. Combination with Silver Ions

The use of silver salts for the determination of carboxyl groups in cellulosic materials has been suggested by Rath and Dolmetsch[7]. They found that only very little silver was bound by the fibers in silver nitrate solutions but that a significant amount was bound in solutions of silver acetate. The latter salt was accordingly suggested for use in this connection. As is shown below, however, not all of the carboxyl groups bind silver when the cellulosic material is immersed in a dilute solution of silver acetate.

The combination of electrodialyzed dewaxed or depectinized cotton with silver ion may be represented by the equation

$$\text{R—COOH} + \text{AgA} \rightleftarrows \text{R—COOAg} + \text{HA} \quad (1)$$

where —COOH represents the acidic groups of the fiber, and AgA represents the particular silver salt under consideration. The extent to which the reaction takes place is determined principally by the competition of silver with hydrogen ions for the acidic groups of the fiber. When silver nitrate is used, a strong acid (nitric) would be formed according to eq. 1 and this would result in a relatively high concentration of hydrogen ions. Under such conditions, not all of the acidic groups of the fiber would be expected to bind silver. If, however, a salt such as silver acetate is used, a weaker acid (acetic) is formed and accordingly a greater amount of silver is bound. When silver *o*-nitrophenolate is used, a still weaker acid (*o*-nitrophenol) is formed and the amount of silver bound correspondingly increases.

In dewaxed cotton, or in depectinized cotton which has been washed with calcium hydroxide, the acidic groups are already in the salt form, and the reaction of these fibers with the silver salts may therefore be represented by the following equation

$$\text{R—COOM} + \text{AgA} \rightleftarrows \text{R—COOAg} + \text{MA} \quad (2)$$

where M represents the cations in the cotton.

Here the extent to which the reaction takes place is determined principally by competition of silver ions with these cations for the acidic groups of the fiber. This system, however, is considerably more complex than that shown in eq. 1, since M may represent a number of different cations. In addition, it must be pointed out that hydrogen ions will also be present (because of hydrolysis of the silver salts, AgA), and these will also compete for the acidic groups of the fiber.

It is obvious that where cations are already present in the fiber or where competition of hydrogen ion (formed according to eq. 1) becomes appreciable, combination with silver ions may be increased by increasing the concentration of silver salt. Unfortunately, data obtained at higher concentration of salt are subject to an error arising from the selective sorption* of water by the fibers and for this reason, concentrations above 0.01 *M* are avoided in the present work.

The combination of electrodialyzed dewaxed and electrodialyzed depectinized cotton as a function of concentration of silver (at equilibrium) is shown graphically in Figure 1. The data were obtained in silver *o*-nitrophenolate solutions. The pH values of the solutions were high enough in all of these experiments so that there could be no appreciable combination of hydrogen ions by the acidic groups of the fiber. The flattening of the curves at higher concentrations indicates that the maximum silver-binding capacity has been approached. Since the maximum concentration of the silver salt solutions is less than 0.01 *M*, no correction for the selective sorption of water by the cotton need be made. Analysis shows that both of the curves of Figure 1

*The effect of this phenomenon and the method of correcting for it are discussed elsewhere[7].

(Continued on page 133)

PROCEEDINGS OF THE

American Association of Textile Chemists and Colorists

MARCH 3, 1941

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CALENDAR OF COMING EVENTS

Meeting, Philadelphia Section, Penn Athletic Club, March 14, 1941.

Spring Meeting, Piedmont Section, George Vanderbilt Hotel, Asheville, North Carolina, April 19, 1941. (Note change in date from April 12.)

Annual Meeting and Convention, Carolina Hotel, Pinehurst, N. C., Oct. 31, Nov. 1, 1941.

WHAT'S NEW IN NEW ENGLAND*

PREAMBLE

THREE hundred and twenty years ago there landed here, a group of pioneers. They came here that they and theirs might have freedom of thought, freedom of speech, religious tolerance, and the right to enjoy the fruits of their ingenuity and their labors.

They were a simple people accustomed to long hours of hard manual labor. They had loyalty, faith, a purpose, a plan, and a determination to do. To them the past was dead—only the future was alive. They did not fear to explore a New World that its future might be moulded to correct the errors of the Old World. Such characters of great strength, tempered in the fires of adversity, were not to be denied.

Heredity is virile and perennial. New England environment a receptive and fertile ground. If these pioneers were leaders, as surely as the day follows the night, their sons should be as the fathers and their spirit spread throughout the nation.

During the years, their progeny developed here in New England at Rowley, Mass., in 1643, the first fulling mill; at Beverly, Mass., in 1787, the first cotton mill; at Hartford, Conn., in 1788, the first woolen mill; at Newburyport, Mass., in 1793, the first manufactory of textile machinery; and at Lowell, Mass., in 1840, the first power driven woolen loom.

They laid here the foundations of a great textile industry that throughout the years has successfully led the textile production of the world.

They founded here institutions of learning that therein all might acquire freely of knowledge and thereby promote the industrial welfare of the community, the state, and the nation. It was here at Boston in 1921, under the leadership of Prof. Louis A. Olney, that the cornerstone was laid for the founding of your Society, THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS, that the interests of the textile industry might be furthered by co-operative exchange of opinion. We are born here, to accept things as we find them but not to leave them as we find them and such being our heritage—we persevere in those things that are of the industry, by the industry, and for the industry; that that industry may not perish, and the labors of our fathers be in vain.

Because such traditions are ours to cherish and because we are of the belief this generation has creditably fulfilled its obligation, The Northern New England Section presents

"WHAT'S NEW IN NEW ENGLAND"

APPLICATION OF PHOTOGRAPHY TO SCREEN PRINTING

While a great deal of the work required in the textile mills is in some respects drab and monotonous in regard to color contrast, the mohair plush industry is exactly contrary to this. Their work is brilliant and beautiful as can be seen by the exhibit on display.

The Massachusetts Mohair Plush Company is responsible, through the efforts of Delbert Ray, for a great deal of new developments in producing these beautiful types of cloths.

The screen printing process which represents an ancient art in some respects has been brought to a high stage of development by means of photographic films and photographic printing on a very large scale. Small patterns may be reproduced from the designer's bench on to screens covering an area as large as twenty-five square feet. The exactness and accuracy with which these large screen prints are made and the application of photography to this principle, has brought screen printing art to a modern stage of development, and makes possible the immediate printing of designs previously requiring a month's time to produce.

Many details have been worked out to accomplish this and to bring about the production of these beautiful fabrics.

(*See article, "Screen Printing of Mohair Plush," page P113.*)

GLASS FABRICS

Cinderella's change from a grimy kitchen maid in the ashes of the fireplace to a dazzling queen with coach and six and those marvelous glass slippers that fitted her foot and hers alone, is no more marvelous as a fairy story that the true story of the transformation of some ordinary glass marbles into the soft shimmering glass fabrics of today. While New England would not take one particle of the credit for this from the splendid work done by Owens Corning Fiberglas Corporation, still in fairness it should be pointed out that the practical weaving of glass cloth in orders of 100,000 yards or more was first handled by the Pacific Mills of Lawrence, Massachusetts. Such cloths are 100 per cent glass, both warp and filling. Possessing great strength but little elasticity: great chemical inertness, but extreme sensitivity to abrasion, the first practical weaving of such fabrics on a commercial basis constitutes a real achievement for Yankee ingenuity. No little skill is also being displayed in the pioneering develop-

*Presented by the Northern New England Section at the Intersectional Contest, Annual Meeting, New York, N. Y., October 18, 1940.

ments toward printing glass fabrics in a multitude of colors by this same New England mill.

(*See article, "Fiberglas Decorative Yarns and Fabrics," page P*115.)

COLOR FASTNESS

As long as cloth is dyed, the question of improved fastness of the colors will be of paramount importance. This involves measuring the fastness properties of what we now have, followed by research work to better them. Both these fields are well illustrated by two recent patents granted the Durfee Company, an old New England association of manufacturing and consulting chemists. First, the Crockmeter, well known to this Association since it was officially sponsored by the A.A.T.C.C. and the patent assigned to us. A simple, inexpensive machine which accurately measures the transfer of color from a dyed material to a white one through rubbing. Secondly, the use of fixing salts to prevent the bleeding of dyed goods into water;—a simple, inexpensive process applied as a cold aftertreatment. This, too, is covered by a U. S. patent.

TEXTILE TESTING

At M. I. T. in the Hub of New England, Professor E. R. Schwarz has listed the following developments from his laboratory. Of particular interest to us, since the A. A. T. C. C. furnished a money grant for this work on evaluating finishes, is the development of the Drapemeter. This instrument gives a delicate way of plotting draping quality. Our only criticism is that a scientist should be so cold blooded as to drape a cloth around an inanimate wooden block when he might use the form divine.

Polaroid—A New England development to prevent glare by producing polarized light through millions of microscopic crystals has been utilized by Dr. Schwarz in a cotton classer's microscope. The maturity of the cotton fibers can thus be determined at a glance and the percentage of immature fibers calculated. Time does not permit more than listing Tech's contributions to microscopic work in textiles:—the microtwist analyzer and micro cross-sectioning:—to the completion of accurate data on moisture strength relationships for cotton:—to unusual textile measurements such as heat transmission and air permeability and all this data corrected and checked by new statistical methods for analyzing the data itself.

FACTAG

Women's curiosity has always been a byword, but Pacific Mills has turned it into a "buying word." They conducted a nation-wide survey to determine what women really want when they buy textiles and found that as a buyer, a woman asks the following questions:—

1. Are the colors fast to light and washing?
2. Of what is the material made?
3. How should it be cleaned?
4. What special characteristics has it?

Of course, the mill knows the answers to these questions. The problem is to get this information to the ultimate consumer through the long chain consisting of cutter up, wholesaler and retail store to that woman in front of the counter. This gap has been bridged by the mill attaching to each garment a little tag giving all these facts in plain English. We call it a "Factag." It tells what serviceability to expect, how to wash or clean the garment, special directions for special uses, etc. As the Factag practically guarantees the garment and as Pacific has thousands of styles and hundreds of colors, the laboratory work to get the complete range of colors in any line into line with the others was enormous. Furthermore, while the color fastness of any one color is well known, it does not follow unfortunately that its fastness when mixed with other colors will stay as expected and 99 per cent of the commercial shades are mixtures of two or more colors. So this meant more work for the laboratory. This New England combination of chemical and business research must be good, however, as Pacific is extending the use of the Factag label into more and more of their lines and is flattered that its competitors have seen fit to imitate this development.

WOOL

For years the standard method of removing burrs and other vegetable matter from wool was to carbonize them with heat and acid, to remove wool grease, scouring with hot soapy solutions was employed. I don't know whether the vagaries of the New England climate are responsible, but within the last few years, a process has been developed there which removes these impurities by freezing them and dusting them out. Quite appropriately, this process is operated and patented by the Frosted Wool Company. Their development work was done at Lowell Textile Institute and the process is now in successful use by the East Weymouth Wool Scouring Company. The method is applicable to many kinds of wool, but only when handled in the grease. Its application to replace carbonization is not claimed. Working at temperatures of —40° to —60° F., it freezes and renders brittle the grease, burrs and dirt so that they can be blown out of the purified wool in a newly designed duster. The process is continuous and automatic and is controlled by an ever-watchful electric eye. Several million pounds of wool have already been successfully handled and the use of the frosted wool process is constantly expanding.

(*See article, "Frosting Wool in New England," page P*122.)

THE DERBY DRY-CLEANER

One of the major new developments in the mill processing of wool has been the invention of the Derby dry

cleaning machine. This invention by a New England chemist for the New England firm of M. T. Stevens, has proved a powerful tool for lowering the costs and improving the quality of woolen textiles. Recent developments have reduced solvent loss through balancing its vapor pressure with the air and the re-use of the recovered oil or grease as a wool lubricant in combing. A complete description of the machine and discussion of its economies has been given by Mr. Roland Derby before Sectional meetings of our Society in both Boston and New York.

MEASURING THE EFFECT OF SPINNING AGENTS ON WOOL

Spinning wool is one of the world's most ancient arts and has recently succumbed to modern science. One factor has always caused trouble,—static electricity, and this in turn is generated by friction and dissipated by conductance. To the modern scientific sleuth, this suggests the elimination of friction by a good conductor. The Monsanto Chemical Company has developed two mechanical gadgets which permit measuring not only the friction but also the static between the yarn and any metal. Knowing this and by trying various lubricants, they feel that on the Noble wool comb 0.3 per cent of oil applied to the machine does as good a job as 3 per cent of oil applied to the stock. Furthermore, by adding neutral phosphates and other conducting inorganic salts developed for this purpose, the static electrical charges developed in spinning are conducted away and dissipated. Science came to the rescue here by the application of simple electrical conductance measurements so that exactly the right chemical and exactly the right amount could be picked for the job. The net result is an easily scoured and dyed, clean spinning wool, stronger and more even yarns and a vote of thanks from the Home of the Worsted Industry of the United States to the Merrimac Division, the New England branch of Monsanto.

(*See article, "Methods of Measuring the Effect of Spinning Agents on the Conductance and Friction Characteristics of Wool," page P*119.)

HARDY SPECTROPHOTOMETER

Unless we are color-blind,—and one man out of every dozen is, but not one woman in a thousand,—color is one of the most important factors in our lives, yet one of the least appreciated. It has been the life work of a New England scientist, Professor Arthur C. Hardy, Sc.D., of M. I. T., to develop an automatic machine which analyzes the rainbow, reducing any color to a curve in black and white, where its spectral reflectance is plotted against all visible wave-lengths in the course of a minute or two. To the human eye, many colors may match under certain lights yet fail to match if the illuminant is changed, but any colors matching by the Hardy machine will always match by any light to any eye. His analysis may be sent by wire to the ends of the earth with the certainty that colors which match his plot, must be identical with the originals. And even more wonderful to me than the perfect matching of unseen colors is that through the use of a Marchant electric calculator, the individual's known aberrations of sight, the variations in lighting, etc., may be calculated in advance telling him what he will see before he actually sees it. For centuries, colors were mixed as on an artist's palette, largely by trial and error. Tomorrow will find chemists writing out prescriptions for a color like a doctor. Over a million such charts have already been made through the actual use of this instrument. Another illustration of New England's contribution to the textile industry.

FLUORESCENT LIGHTING

"What is so rare as a day in June,
Then if ever come perfect days"

is no longer true at the Hygrade Sylvania plant in Salem, Massachusetts, where every day is a perfect June day—as far as daylight is concerned.

Fluorescent lamps produce light not through heating a wire to incandescence, but rather through the action of ultra violet radiation upon "phosphors," or fluorescent substances, that line the glass cylinder. The invisible ultra violet light is thus converted by the phosphors, and re-radiated at longer, visible, wavelengths.

Unlike incandescent concentrated light sources, this new lamp emits light from its entire surface. Each tiny particle of fluorescent substance acts as an individual source of light. Consequently, a soft, perfectly diffused light that reduces glare, and shadows, and is the coolest light ever developed is the result. The greatly increased efficiency affords the opportunity to improve factory lighting without the expense of rewiring circuits already loaded to capacity in many instances.

By properly blending the various "phosphors" of fluorescent materials, several beautiful and brilliant colors are produced such as:

Blue, Green, Pink, Gold, Red, Blue White

as well as the Whites and Daylight for general lighting purposes.

Textile installations in weave sheds, spinning rooms, perches, offices, and particularly for "matching off" in dyehouses, deserve the most complimentary mention.

One of the major contributions of Hygrade engineers is the Cox patent, 2,096,693, which covers the development of a viscous membrane that allows the "phosphors" to adhere to the glass as separate particles. Thus the maximum amount of light comes through the glass tubing—a glorious, clear, June daylight.

And, it is fitting that Salem, Massachusetts, should be the home of this discovery for there:—

Alexander Graham Bell developed the telephone;

Moses Gerrish Farmer with a wet cell battery and a

crude lamp gave the world the spark that led to Edison's first incandescent bulb.

Now, thanks to James Cox, *you* have lived to see a *miracle in lighting—a man-made package of sunlight.*

And the dream of the centuries of scientists to dispell darkness with daylight becomes an accomplished fact.

(See article, "Fluorescent Lighting for the Textile Industry," page P123.)

CONCLUSION

To those who have done these things we are grateful. May their citation here serve as an inspiration to those of the generation who are to assume our responsibilities. May they rise to even greater heights than those of the past and we of the present.

For an obligation accepted and creditably discharged there is no greater reward than the world acclaim, "Well done, thou good and faithful servant." May such be theirs. Thus does an industry or a nation prosper.

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1st Cotton Mill—"Essex Institute Historical Collections." Vol. XXXIII.

1st Woolen Mill—"The American Wool Manufacturers." Vol. I, p. 64.

1st Mach. Manufactory—"The American Wool Manufacturers." Vol I, p. 89.

Committee of Northern New England Section which prepared this paper and its accompanying presentation:

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Roland Derby, *Director, Educational Tours*
John Dalton, *Asst. Stage Manager*
Henry D. Grimes, *Sound Effects*

"What's New in New England"—

SCREEN PRINTING OF MOHAIR PLUSH

Advantages

IT can be done cheaply, quickly and easily, requiring a minimum of skilled labor. Operatives having some training in drafting or designing can very easily be taught to make screens.

The colors are brighter and bloomier because no great pressure is required in their application. The colors do not come into contact with metals which might influence them. This also allows of a greater range of colors from which to make a selection. There is no waste of color, no setting up of equipment and subsequently no loss of time. As no back greys are required, a tremendous saving makes this form of printing very economical.

Chlorination, once regarded as a must in wool printing in order to establish an affinity for the color, has long since been abandoned.

With the print table once prepared properly, the only change from pattern to pattern will be the resetting of the stops to suit the required pattern.

Screens

Wooden frames are generally used. These frames are usually made of clear, straight grained, seasoned pine or cedar, the former preferred. Corners are dovetailed for rigid construction. The frames are well varnished or painted in order to withstand repeated washings.

Silk bolting cloth of fine metal screen is tacked to the frame, being drawn very taut during this process. In the case where silk bolting cloth is used, the silk is shrunk and dried on the frame before the pattern is applied. For heavy goods and pile fabrics, silk bolting cloth has had the preference.

The pattern can be applied by one of several methods:

(1) Profilm—which is a transparent lacquer applied to a transparent paper backing. By means of a studio knife, the pattern is cut out of the lacquer without cutting into the backing material. The Profilm is then placed on the silk. The lacquer is transferred from the backing material to the silk by means of a suitable solvent.

(2) The pattern may be painted directly on the screen with water soluble paint. The whole surface of the screen, after drying, is well varnished or lacquered. This must be allowed sufficient time to dry hard. The water soluble paint is then removed by washing from the reverse side. A brushing of the ragged edges may be necessary to secure a sharper outline.

(3) The pattern may be traced directly on the screen and varnished in by hand. This method is slow and expensive, but a heavy coating can be built up which will give long life to the screen.

(4) The Photographic Method:—The screen is sensitized with a bichromate-gelatin-glue solution and dried. A contact print is then made on the screen with the pat-

tern as the negative. The areas of the sensitized screen acted upon by light then become insoluble in water. The screen is then washed in hot water dissolving out the unexposed areas. A coating of varnish or lacquer may be applied to both sides of the screen.

Colors and Thickeners

Wool printing has come into prominence only in the last few years. Very few colors are available for this type of printing. Therefore, those colors which meet with all requirements are selected. The selection narrows down to two groups; namely, acid colors and chrome acid colors. Bright shades are usually matched with acid colors, while chrome acid colors cover the range of full, deep shades. Great care must be used in the selection of individual colors which are to be used for the making up of shades. Good solubility of the colors is one of the major requirements. They must also be fast to light, crocking and perspiration.

These colors must work well with various types of thickeners which may be used. Troubles, such as precipitation and settling out of color, foaming and thinning of the print paste, must be guarded against. Thickeners that have a tendency to set or dry too quickly may block up some of the fine mesh of the screen.

Tables

The tables are usually constructed of wood or steel framework with the bed made up of wood, steel or slate. On this is placed a layer of good quality felt, this felt is then covered with cotton cloth or oilcloth. The latter preferred because of ease of cleaning. The importance of the bed cannot be magnified. The success of the printing may depend on the condition of the bed. When wood construction is used for the bed, it should be rough planed and then sanded so as to form a level surface. If there are humps and hollows present, naturally there will be uneven blotches in the printing in the form of light and heavy places. The tables run from fifty yards to one hundred yards in length. The material to be printed is securely fastened to the top covering usually by pinning the selvages. This must be done in such a manner that there will be neither creep nor slack in the plush which could distort the pattern.

In order to guide the passage of the screens down the table while printing, an angle iron (one edge up) may be fastened to the edge, on each side of the table. The screens are placed firmly against this when ready to print.

Stops, which are pieces of metal made to be movable, are fastened with a set screw for repeats of the pattern.

Printing, Ageing and Scouring

The stops having been set for the repeat of a pattern, the men are ready to print. For wide plush, two men and a color boy are necessary. The color is poured into one end of a screen which is called the reservoir. The squeegee is passed back and forth across the table two or more times until the proper degree of penetration is obtained. The screen is then lifted and moved along to the next pair of stops and set down so that the two points of contact on the screen coincide with the stops. This operation is repeated until the piece is printed, the color boy adding color at definite intervals. Uniform pressure must be applied by each squeegee worker or uneven blotches will result. Sometimes weights are added to the squeegee in order to obtain better penetration of color. The screens are well washed immediately after printing. Sometimes a little brushing is necessary to open up the mesh when some of the thickening has dried in.

Where multi-colored printing is called for two methods may be followed.

(1) The entire piece may be printed with the first color, then the second color is printed. This procedure is followed for the necessary number of colors.

(2) On the other hand, if the production is large enough, a crew may be used for each color in the pattern, one following the other down the table.

The pieces are then air dried. Unless there is ample moisture present in the Ager the pieces should not be too well dried. A dried out paste on the fiber will not impart its colors to Mohair or Wool.

There are two methods by which the pieces can be aged:

First—Open width, whereby the pieces are aged without pressure. This gives excellent uniformity but generally does not give maximum development or fixation.

Second—Ageing in a Cottage steamer under pressure. This pressure varying from one to five pounds. The time, one-half to one and one-half hours, depending upon the type of color used and the amount applied.

The degree of scouring depends upon the type of thickening which has been used. Ordinarily the types which prove satisfactory in all respects for screen printing can be easily washed out in a weak soap solution at low temperatures. The pieces are then well rinsed, extracted and dried.

"What's New in New England"—

FIBERGLAS DECORATIVE YARNS AND FABRICS

FIBERGLAS decorative yarns are all glass yarns used in the production of decorative fabrics of various types. These yarns are furnished to textile manufacturers for conversion into thread, cloths, tapes, braids and similar decorative materials. Yarns of various types may be used in combinations to produce novelty effects and to produce materials of various weights and sheens. No decorative fabrics are woven or sold direct by Owens-Corning Fiberglas Corporation.

Decorative yarns are available in white and in these colors: light blue, grey, dark blue, light ecru, dark ecru, and dark brown. In all colored yarns except grey, the coloring material is a part of the glass itself rather than a surface dye.

Decorative white yarns are made of the same glass composition as that in Fiberglas electrical yarns. The colored yarns are made from glass developed and standardized for decorative purposes.

Two Forms: Staple Fiber and Continuous Filament

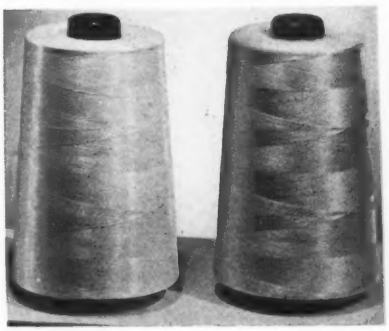
Fiberglas decorative yarns are of two types, made by different methods that give the basic fibers different physical characteristics. Staple fiber is produced by steam drawing of the molten glass into fibers that have a general resemblance to cotton or worsted fibers in their subsequent textile processing. Continuous filament is produced by mechanical drawing of the molten glass into strands of indefinite length (measured in miles) that have a general resemblance to natural silk in the manner in which they are later processed.

Both fibers, of course, are inorganic, incombustible, durable, non-absorbent, and non-hygroscopic—properties derived from the familiar characteristics of glass. In addition, they are resilient, extremely flexible, and have extraordinary tensile strength, exceeding that of the strongest steel piano wire—properties peculiar to glass in the form of fine fibers.

Only white yarn is available at present in staple fiber form but white and all six standard colors may be obtained in continuous filament yarns.

Staple Fiber Characteristics

Though the term "staple" is used to distinguish these fibers from continuous filament Fiberglas, the length of the individual fibers is so much greater than the familiar staple lengths of cotton or sheep's wool, that the term "superstaple" would characterize them better. The length varies up to 15" or more, with an average length of about 9". The fiber diameter averages .00027". The individual fibers are smooth and substantially cylindrical.



These yarns are available in continuous filament and staple fiber form. Note characteristic fuzziness of the cone of staple fiber yarn.

A small amount of mineral oil lubricant is used on staple fibers. This lubricant improves the processing characteristics and minimizes the friction between the individual fibers which tends to cause scratching and breakage. This lubricant readily may be removed by washing with soap and hot water, with carbon tetrachloride or with ether.

Continuous Filament Characteristics

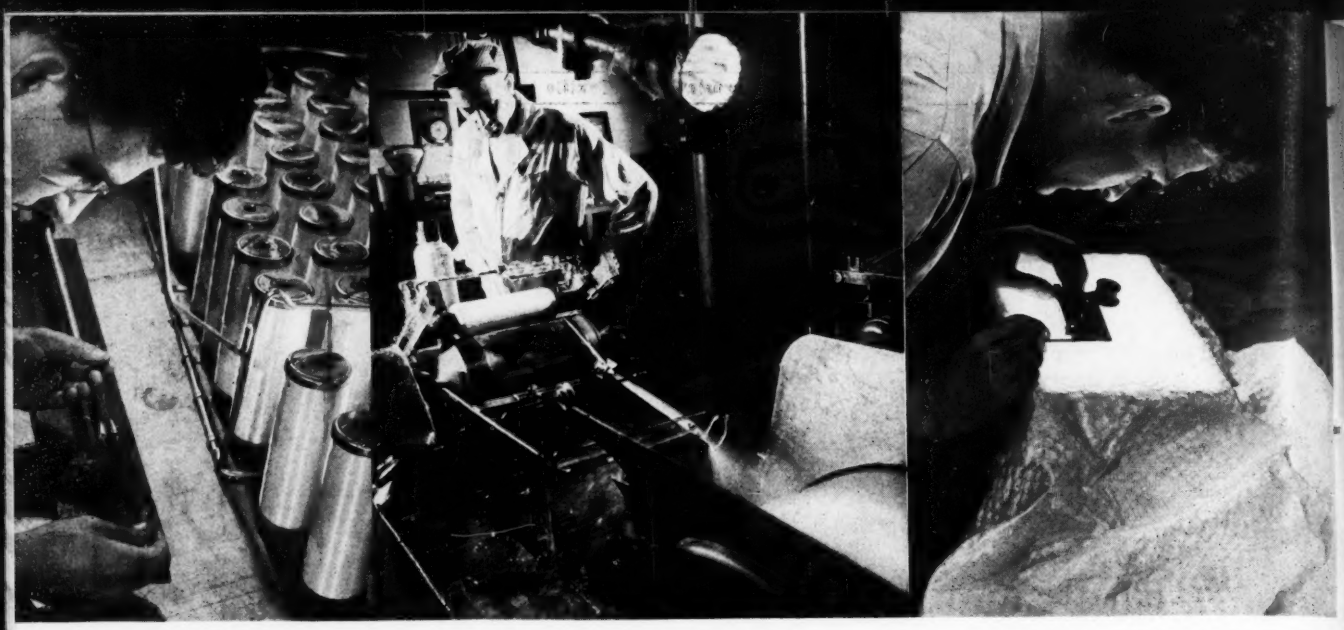
Fiberglas in continuous filament form is unique in that the glass is drawn continuously to indefinite lengths, the latter being limited only by the problems of packaging. The average diameter of the individual filaments is .00022", but the filaments from a large number of orifices are immediately combined and wound together to form a fine strand. Glass filaments made in this manner are smooth and cylindrical.

A small amount of lubricant and coating is used on the continuous strand. This material serves to facilitate manufacturing operations, and to keep the individual glass fibers apart. Glass fibers may be thought of as very small glass rods which few substances will scratch, but which will scratch each other.

The coating used on continuous filament generally is composed of starch and vegetable oil. It may be readily removed by washing with soap in hot water. Being organic, it is also removable by heating the finished textile at 600° to 700° F. in a well ventilated oven for one hour.

Processing of Staple Fiber

Staple fiber is blown onto a traveling belt in the form of a web or ribbon of interlaced fibers, from which it is gathered, without twist, as a "sliver." In the gathering process the fibers are slightly drafted so that the majority lie parallel to the length of the strands.



Counting twist per inch.

Staple fibers are produced by steam drawing of the molten glass.

Inspecting finished cloth.

This is the "raw material" of staple fiber rovings and yarns. A roving is a sliver with low twist and is formed by simply twisting the sliver on a standard twister, or flyer twister. A yarn is a sliver or roving given a higher twist. Fine yarns of Fiberglas staple fiber are made by drafting sliver in a manner quite similar to the worsted spinning process. Coarse yarns are made without drafting.

Standard textile machinery is employed in all cases, after slight modifications and adjustment found desirable in plant operations.

Staple Fiber "Count"

The method used to designate the size of staple fiber slivers, rovings and yarns is a simplified method that differs from cotton, silk, or worsted systems. The adoption of a special system was made necessary by the fact that Fiberglas has a different density than these organic fibers. The count or number is based on the yardage of raw glass in a pound. The number of the yarn, multiplied by 100, is the nominal yardage of raw glass fiber in a pound. Thus a 75 yarn has 7,500 nominal yards per pound; a 100 yarn has 10,000 nominal yards per pound, etc.

If the yarn consists of one roving given a certain twist, its construction would be denoted by the number "75-1." If it consisted of two rovings of yarns the construction would be denoted by "75-2."

This nominal yardage may exceed the actual yardage for two reasons: first, the count or number does not take into consideration the weight of the binder material which is always present, but which may vary according to the quantity and type of binder employed. This, in turn, may vary with the purpose for which the yarn is intended.

Second, the nominal yardage is based on theoretically parallel fibers without twist. There is always some shrinkage in length due to twist; thus the difference between nominal and actual yardage may be greater for yarns of high twist than for sliver, roving, or low twist yarns. Similar allowances are involved in other count systems, but in all cases, the count, though based on nominal yardage per pound, gives a reliable index of the size of the yarn.

Processing of Continuous Filament

Fiberglas continuous filament is drawn into a strand that combines the individual filaments from 102 or more orifices.

These strands of filaments are drawn without twist, one strand or more being twisted together to form a fine yarn. Thereafter the yarns may be plied by twisting two or more together to provide any desired yarn, thread, or cord construction.

In a sense, the original strand is the "sliver" of the continuous filament process, but in this case all fibers are substantially continuous and lie parallel in the strand. A smooth yarn results.

Here again standard textile machinery is employed for twisting and plying operations after suitable modifications and adjustments. The tensile strength and workability of continuous filament is evidenced by the fact that the original drawing and winding operation is run at a speed of more than a mile a minute.

Continuous Filament "Count"

The same system employed with Fiberglas staple fiber rovings and yarns is used to designate the size and construction of Fiberglas continuous filament yarn. That is, the count number, multiplied by 100, indicates the nominal yardage in a pound of yarn. Again the nominal yardage is based on the "raw" glass fibers alone, without regard for the weight of the binder or the shrinkage due to twist.

A 900 yarn thus has a nominal yardage of 90,000 yards to the pound of glass fiber. When two strands are twisted together the construction is indicated by 900-2/0. If two

such twisted yarns were then combined, the resultant plied yarn is designated as 900-2/2. There would then be four strands in the yarn; hence its nominal yardage would be 90,000 ÷ 4 = 22,500 yards, and its actual net length would be 22,500 yards less the shrinkage due to twist and the effect upon weight of the binder employed.

Twist and Ply

Twist is designated as Turns Per Inch, or T.P.I. and its direction by the letters "S" or "Z." A yarn or cord has "S" twist if, when held in a vertical position, the spirals conform in slope to the central portion of the letter "S," and "Z" twist if the spirals conform in slope to the central portion of the letter "Z."

Balanced construction results when the twisted yarns are plied with an opposite twist; the second ply offsets the tendency of the first twist to unwind.

Physical Properties

The tensile strength of Fiberglas yarns is substantially in excess of the strength of yarns of the same construction and comparable size made of cotton, rayon or silk. Greater strength is present in Fiberglas yarns than is needed in any of the applications so far developed. The yarns do not stretch or shrink, are mildew-proof, moth-proof, rust-proof, and vermin-proof, all very desirable characteristics in the decorative field.

In physical appearance, Fiberglas staple yarns may be distinguished from Fiberglas continuous filament yarns by a characteristic slight "fuzziness" which is almost totally lacking in the smooth continuous filament yarns.

Colored Yarns

The coloring material in the standard colored glass yarns (except grey) is incorporated in the manufacture of the glass itself and is not a process of dyeing the yarn as is the case in cotton and rayon. As a result, the colored yarns are truly color-fast and are not affected by exposure to direct sunlight or washing.

Dyed Yarns

Fiberglas yarns can be dyed and some small quantities are now available. The Owens-Corning Fiberglas Corporation does no dyeing of yarns but furnishes standard glass yarns to mills which in turn do the work or have it done.

All dyed samples so far produced are subject to slight crocking but some have shown little or no fading due to washing or to exposure to ultra-violet light in the Fade-O-Meter. The corporation assumes no responsibility for the Fiberglas yarns that have been dyed or treated in such a manner that the color is no longer that of standard Fiberglas yarn.

Fluid for Splicing Decorative Yarns

Methyl methacrylate fluid is recommended for splicing Fiberglas decorative yarns and for treating seams and raw edges of Fiberglas fabrics. Its composition is as follows:

Methyl methacrylate (powdered resin) ..... 10 points by weight
Lindol A (tricresyl phosphate)..... 4 points by weight
Toluene (solvent) ..... 80 points by weight

Mixing Procedure. Mix the methyl methacrylate in the toluene (cold). Heat on a hot plate or over a water bath almost to the boiling point of the mixture, agitating slowly during the heating period. After all the particles have gone into solution, remove from heat and add the lindol. Cork the solution tightly to prevent loss of solvent. If solution becomes too thick dilute with more toluene.

Decorative Fabrics

Fabrics made of Fiberglas decorative yarns are unique in the field of decorative textiles.

They are highly heat resistant and absolutely fireproof.

They are practically soilproof—dust or dirt remains on the surface much the same as flecks of dust on a mirror, and can be wiped off with a damp cloth. For thorough cleansing they should be "dunked" in warm water suds.

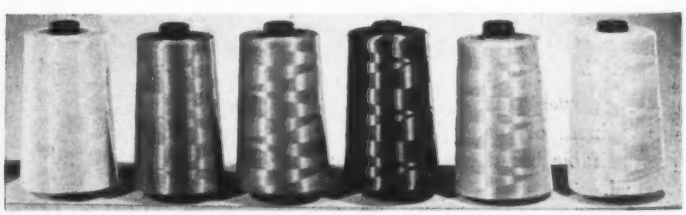
They are definitely mildew and vermin proof.

They are not affected by climatic conditions, and therefore will not sag or shrink.

Fabrics made of colored yarns are color-fast.

Gleaming damasks, shimmering brocades, lustrous satins, rustling taffetas, and sheer nets—available in nearly a score of designs—are finding wide application in home interiors, offices, hotels, restaurants, clubs, ocean liners, airplanes, railroad cars and elsewhere. These applications are typical:

1. Table cloths. Fiberglas cloths present an unusually decorative effect for silver, glass and flatware. Lighted cigarettes are no longer a menace, for these cloths will not burn.

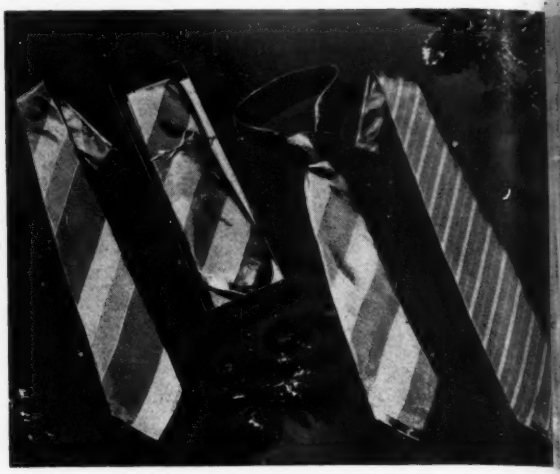


LEFT—Winding continuous filaments at more than a mile a minute. BELOW—Fiberglas decorative yarns in white, dark ecru, light ecru, dark blue and light blue. Brown and gray also can be obtained.

Lamp Shades

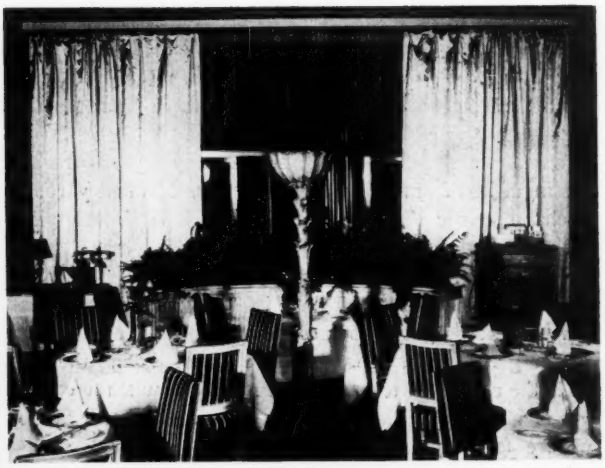
Store Window Backgrounds

APPLICATIONS OF FIBERGLAS



Neckties

Shower Curtains



ABOVE—Window Draperies

BELOW—Tablecloths

2. Lamp shades. Because Fiberglas fabrics are absolutely fireproof they are ideal for lampshades. Such shades are easily cleaned.

3. Neckties. Fiberglas cloths are desirable for neckwear and accessories because of their beauty, and the fact that they are easily cleaned.

4. Draperies. Hanging in long, graceful, even folds there is a richness about Fiberglas draperies that enhances the appearance of home interiors.

5. Window dressing. Fiberglas fabrics blend beautifully into backgrounds and are used in a number of smart shops to set off certain articles of merchandise in an atmosphere of luxury. These fabrics will not fade.

6. Shower curtains. In addition to adding to the cheerfulness of the bathroom, Fiberglas shower curtains are desirable because they will not mildew, and are easily cleaned.

"What's New in New England"—

Methods of Measuring the EFFECT OF SPINNING AGENTS on the Conductance and Friction Characteristics of Wool

COLVER P. DYER

MILL tests with modified phosphates have shown that these water soluble agents give very satisfactory results in the spinning of woolens and worsteds. The reasons for the behavior of such phosphates in spinning have been of interest to us.

Hugh Christison of the Arlington Mills first suggested that the action of these spinning agents might be explained by their antistatic properties. To prove this point we adapted the method of Murphy and Walker* to our purpose.

The relative degree of fiber to metal friction seemed to us a reasonable method for determining combing properties of wools, containing various agents. The methods for carrying out these comparative measurements are shown in this paper.

A. Method of Measuring the Conductance of Wool

Five gm. skeins of scoured yarn were treated with various amounts of various agents and wound on the electrodes A and E (plates 1 and 1A). The electrode alone as shown in E is made so that the free space between the

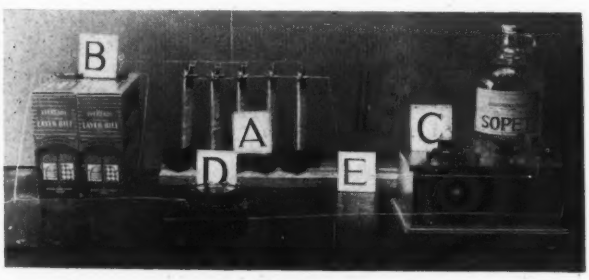


Plate 1

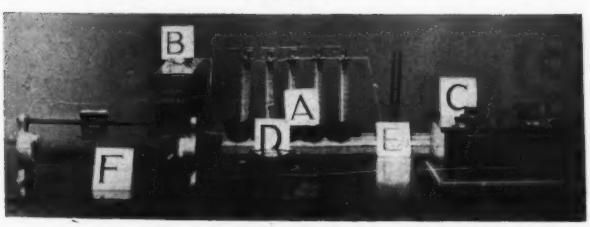


Plate 1A

rods is 1.3 cm. This electrode is turned at 120 RPM and the yarn wound on for 75 seconds giving 150 turns or 300 wool yarns across the 1.3 cm. per electrode.

It is important to have as even a tension on the yarn during winding as is possible. A number of simple gadgets have been devised for obtaining this even tension and even spacing of the windings but they need not be described here.

In determining the conductance of wool, five electrodes were customarily used. The current passes from the high voltage "B" batteries, B thru the voltmeter D to the galvanometer, a Leeds and Northrup quinhydrone pH potentiometer C, and back thru the electrodes A, connected in parallel.

The voltage required to cause a small but definite amount of current to flow thru the wool was used as a measure of conductance. In measuring conductance the voltage was adjusted to give a deflection of 5 units on the galvanometer except in those cases where the conductance was so low that only one unit of deflection could be obtained with the highest voltage available to us.

For example, with untreated yarn and a potential of 120 volts the galvanometer deflection was less than 1 unit whereas a yarn impregnated with 11.2 per cent Sopet required only .9 volts to give a galvanometer reading of 5 units.

5 x 1 galvanometer units = 5 x 120 = 600 volts for untreated wool whereas, .9 volts, only, was required to cause the same current (5 galvanometer units) to flow thru the yarn treated with 11.2 per cent Sopet. The conductance of this Sopet wool was 600 to 700 times that of untreated wool.

The curves in plates 2 and 3 show characteristic results expressed in terms of conductance increase over untreated or oiled wool.

Plate 2 shows that wools, which do not contain an electrolyte such as oiled wool or wool containing diethylene glycol, have little if any conductance.

These curves indicate that modified phosphates can increase the conductance of wool many times, in fact as much as 700 to 1,000 fold.

It should be pointed out that to prevent the build up of static only a certain degree of conductance is necessary. When the conductance of a wool is high enough to cause the immediate discharge of any static caused by friction the value of any additional amounts of anti-static agent are questionable. In practice we have found that from 1 to 3 per cent of the agent is sufficient to give good spinning. In demonstrating the effectiveness of anti-static agents in

*J. Physical Chemistry, Vol. 32, p. 1761 (1928).

PLATE 2

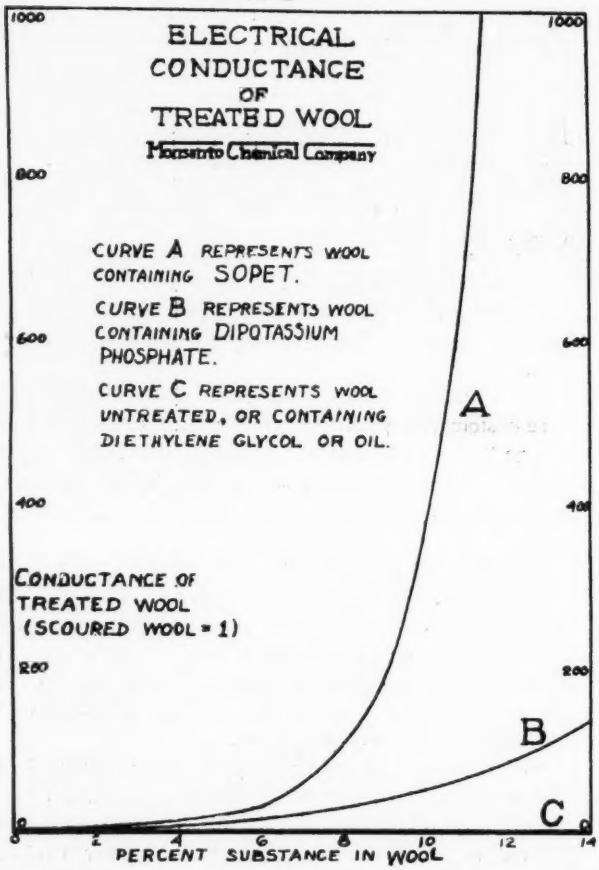
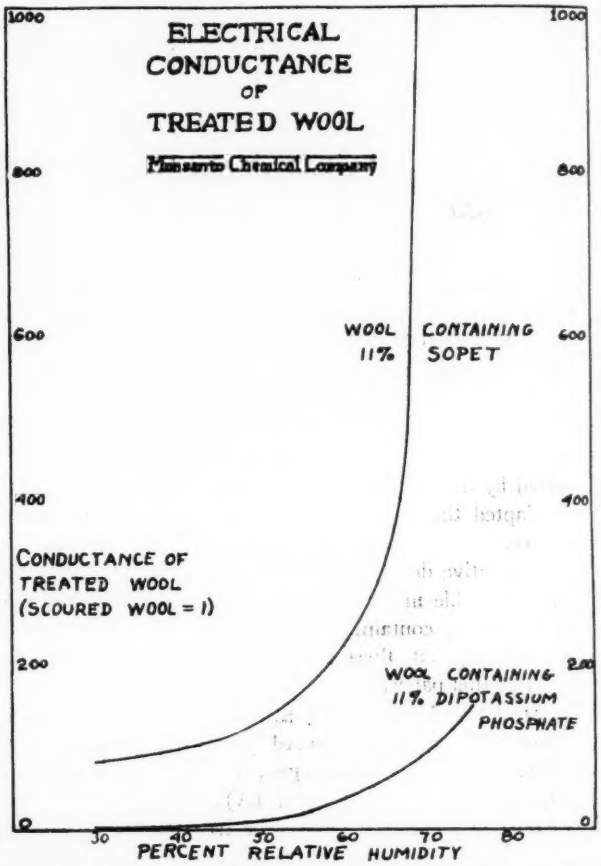


PLATE 3



causing increased conductance we exaggerate the practical mill quantities of these agents in order to better show the fundamental effect.

Since these conductance figures show increases up to a 1,000 times that of blank wool, we felt that extreme accuracy was not needed and therefore we made use of easily available laboratory apparatus.

From these measurements we concluded that at least a large part of the effectiveness of modified phosphates as spinning agents was due to their anti-static effect. Oil apparently reduces friction to a point where it will not cause the formation of static whereas modified phosphates prevent the build up of static by causing its immediate discharge.

B. Comparative Measurements of Fiber to Metal Friction

Scoured wool yarns were impregnated with various amounts of oils and water soluble phosphates. After drying, the 5 gm. skeins were wound on the drum A (Plate 4). This drum turns in a well oiled bearing so that the resistance of the bearing is as nearly uniform as possible. The yarn is then led over a series of polished stainless steel rods as shown in B and up thru a hook in the scale C. The yarn is pulled thru the friction surfaces B by being

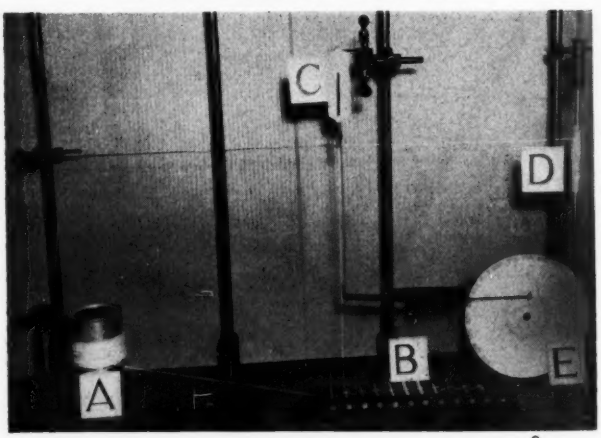
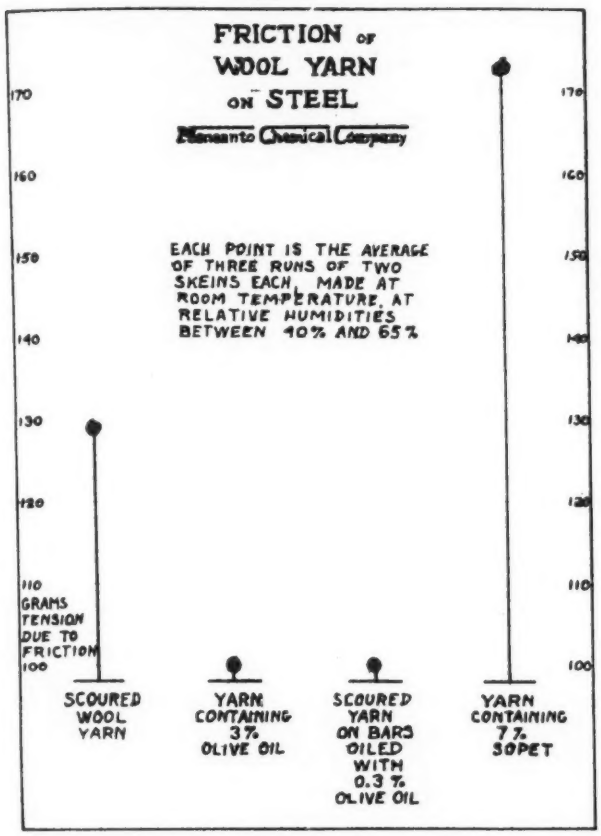


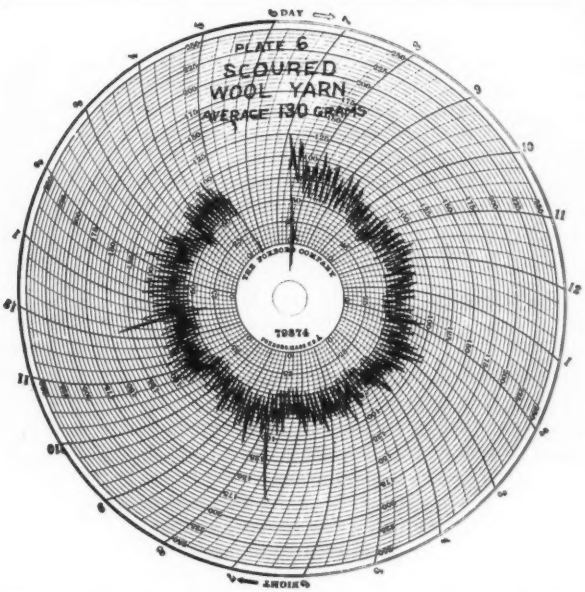
Plate 4

wound around the ⅜ inch shaft D turning at 120 RPM. The reading of scale C is continuously recorded on chart E thru the arms connecting the scale with the chart pen. The arm lengths are so designed that a reading of 50 gms. on the chart is equal to 100 gm. real frictional resistance as shown by the scale.

The speed of the chart is so adjusted that the chart makes one revolution in about 10 minutes which is the

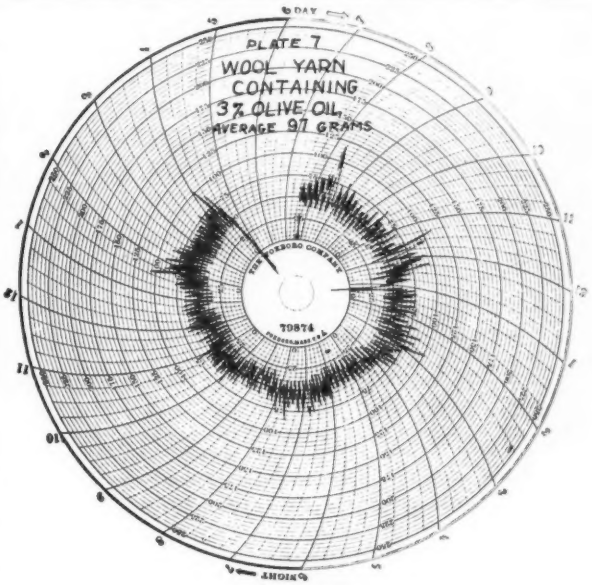
PLATE 5

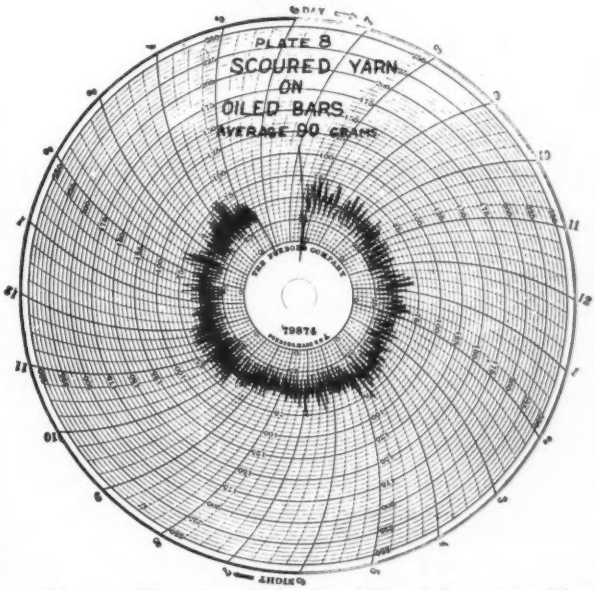

FRICTION OF WOOL YARN ON STEEL
Monsanto Chemical Company
EACH POINT IS THE AVERAGE OF THREE RUNS OF TWO SKEINS EACH, MADE AT ROOM TEMPERATURE, AT RELATIVE HUMIDITIES BETWEEN 40% AND 65%
170
160
150
140
130
120
110
100
GRAMS TENSION DUE TO FRICTION
SCOURED WOOL YARN
YARN CONTAINING 3% OLIVE OIL
SCOURED YARN ON BARS OILED WITH 0.3% OLIVE OIL
YARN CONTAINING 7% SOPET



time required to pull one 5 gm. skein from A thru the resistance B to the shaft D.

The chart is then removed and the average reading obtained by running an ordinary chart planimeter over the curve made by the pen.

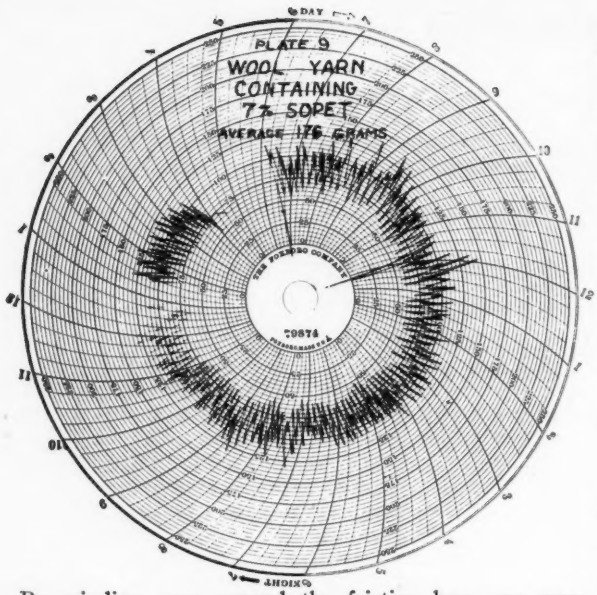




By controlling the relative humidity of the room with an automatic humidifier we were able to obtain comparative friction figures under varying conditions.

Plate 5 shows a few comparative frictional readings. Plates 6, 7, 8, 9 show actual charts obtained with yarns of varied treatments.

When very fine wools are treated with modified phosphates, difficulties are experienced in combing. It is well known that W. O. or unoiled wool does not comb as easily as wool containing 3 per cent oil. A fine wool containing 3 per cent of a modified phosphate cannot be successfully combed without a high percentage of noil. Plate 5 indicates that the explanation of this difficulty lies in the high fiber to metal friction of a wool treated with the phosphate.



By winding yarn around the friction bars one may obtain a fiber to fiber friction measurement. In such measurements we were unable to discover significant differences in friction between oiled wool and phosphate treated wool. A drag out test made by an outside laboratory obtained very similar results.

In the case of coarse wools the anti-static agents do not cause trouble. This fact is explained by the larger fiber diameter and greater strength of the coarse wool as well as by the wider settings of the circle pins.

The practical mill man often needs to judge the combability of wool. This inexpensive and simple friction apparatus makes it possible to obtain actual comparative figures from which the effect of new agents on combing may be predicted.

As a practical example of how these data may be used one can readily see from plate 2 that .3 per cent oil on the wool weight applied to the friction surfaces gives a friction just as low as is obtained if 3 per cent oil is applied to the wool in a previous operation.

This led us to the idea of oiling the pins of a Noble comb rather than oiling the wool with a consequent saving in oil.

As a practical test of these conclusions 250 lbs. of a very fine dry wool were combed on a noble comb. The average of 6 (15-20 min.) weight-offs showed 24.87 per cent noil with a production of 28.38 lbs. We then installed a very simple oiling brush on the two circles before each dabbing brush and applied oil at the rate of .5 per cent on the wool weight. The average noilage was then 23.88 per cent and the production rate 29.49 lbs. per hour.

Thus by applying the data obtained with this simple laboratory machine we were able to show how to obtain a 1 per cent decrease in noilage on dry wool without raising the oil content above practical dry top specifications.

Conclusions

The evaluation of new agents in the combing or spinning of wool is often difficult and expensive when carried out on a mill scale. Measurements of conductance and fiber to metal friction by the simple and inexpensive apparatus described here afford a ready method of obtaining preliminary data from which practical predictions may be made. By the use of these data mill trials on impractical agents may be avoided.

Agents which may give excellent results in one process may cause trouble in another. This is shown by the fact that the modified phosphates promote excellent spinning but cause trouble in combing fine wools. By applying these agents subsequent to the combing process these materials may be used to a decided advantage.

"What's New in New England"—

Frosting Wool in New England

SEVERAL years ago a new method of deburring and cleansing wools was discovered. This process was developed and patented by the Frosted Wool Process Company. A pilot plant was built and operated for many months at the Lowell Textile Institute, during which time many experiments and changes were made. A full sized commercial unit was then installed which was moved and rebuilt in the plant of The East Weymouth Wool Scouring Company, East Weymouth, Massachusetts, in November, 1936. Here further experimental work was carried on and extensive changes were made particularly in the methods of moving the wool throughout the process. On January 1, 1938, this unit was accepted and is now in operation by The East Weymouth Wool Scouring Company.

The process was developed for cleansing and removing the vegetable matter from wool and is applicable to many wools, but will not successfully handle all types especially in competition with the carbonizing process required for extremely fine work.

The wools are handled in the grease only, and at a temperature ranging from minus 40 F. to minus 60 F. Many difficulties had to be overcome to enable this work to be carried on at such low temperatures.

The operation of the machine is automatic and controlled by an electric eye device. Many adjustments are possible for different types of wool.

The machine consists of a refrigerating unit and the cleansing unit. The wool is frozen on an open screen which continuously feeds the wool to a "batch" duster of new design, here it is cleansed for different intervals of time and then removed by an air conveyor system, screened and then delivered from the machine through an automatic sealing device. The removed burrs, dirt and grease are automatically delivered from the machine.

Several millions of pounds of wool have been successfully handled by this process and its uses are constantly increasing.

If it's new—New England uses it.

Operated under patents:—1,866,205, 1,894,154, 1,990,-120, 2,015,893 and 2,015,894.

"What's New in New England"—

FLUORESCENT LIGHTING FOR THE TEXTILE INDUSTRY

HARRIS REINHARDT*

THE fluorescent lamp is the most important light source which has been developed since the invention of the incandescent lamp. The outstanding advantages of this new light source may be summarized as follows:

1. *High Efficiency*—which makes possible desirable increases in illumination levels.
2. *Cool Light*—which makes possible the use of high level lighting without the generation of excessive heat.
3. *Long Length*—which makes possible greater uniformity of illumination, better diffusion and softer shadow than is possible with concentrated sources.
4. *Low Brightness*—which reduces the danger of both direct and reflected glare.
5. *Daylight Color*—which makes possible the liberal use of artificial daylight for color discrimination and many forms of color matching.

Anyone who is familiar with the lighting requirements of the textile industry realizes that there has long been a need for a light source having these characteristics. The enthusiastic reception of the fluorescent lamps in this industry and the numerous successful applications which have been made gives an indication of the important part which fluorescent lamps may be expected to play in future lighting in the textile industry.

Operating Principle

The principle of light production employed in the fluorescent lamp was known to science for hundreds of years before it was applied in a practical light source, just as the principle of the incandescent lamp was known for many years before the invention of a practical lamp of this type. Incandescence refers to the production of light by heating a substance to a high temperature; fluorescence refers to the conversion of invisible radiant energy into visible light of a longer wavelength. In the fluorescent lamp invisible ultra-violet energy of 2,537 Angstroms in wavelength produced by the flow of an electrical current through mercury vapor at a low pressure is converted into visible light through the action of fluorescent powders or phosphors coated on the inside surface of the lamps.

Fluorescent lamps are tubular in shape and are available in several different sizes, as shown in the accompanying table which gives the essential technical details of the lamps. The lamps have a special type of bi-pin base at the ends, and each of these is connected to a small oxide coated tungsten electrode which must be preheated during the starting period. This principle of preheating the electrodes makes it possible to operate the lamps from normal line voltages, as distinguished from the cold cathode type of gaseous discharge tube such as sign tubing, which requires a high voltage. The proper conditions for the establishment of the arc are provided by auxiliary equipment which will be discussed in greater detail later. The mercury arc produces a small amount of visible light and a rich supply of invisible ultra-violet radiations which are used to excite the phosphors in the manner previously discussed.

Colors

The wavelength or color of the light produced in the fluorescent lamp depends upon the characteristics of the phosphors used in coating the inside of the lamp. The lamps are available in a white color which resembles the light from a high wattage incandescent lamp, a daylight which resembles average daylight from the sun and sky

*Commercial Engineer, Hygrade Sylvania Corporation, Salem, Mass.

ESSENTIAL TECHNICAL DATA ON FLUORESCENT LAMPS

Bulb	18" T8	18" T12	24" T12	36" T8	48"T12	60" T17
Bulb diameter	1"	1½"	1½"	1"	1½"	2⅛"
Nominal lamp watts*	15	15	20	30	40	100
Nominal lamp amperes	.30	33	.35	.33	.42	1.4
Nominal lamp volts	56	48	62	103	108	80
Nominal line volts	110-125	110-125	110-125	110-125 199-216 220-250	110-125 199-216 220-250	110-125 **** ****
Rated average life** (Hours)	2500	2500	2500	2500	2500	2000
Approximate initial lumens***						
White	585	585	900	1450	2100	4200
Daylight	495	495	760	1250	1800	3800

*Wattage of lamp only. Wattage lost in auxiliary equipment must be included to obtain total wattage.
**Life under specified test conditions.
***Approximate lumens under specified test conditions. Initial values apply after 100 hours of operation.
****Ballast for voltage ranges other than 110-125 will probably be available later.

and in five additional colors—blue, gold, green, pink and red.

The white lamp is somewhat more efficient than the daylight lamp and it is sometimes preferred, both because of this and because of its warmer colors for many applications except those where light of daylight color is required.

Daylight Quality

Where light of daylight quality is required the daylight fluorescent lamp is the most efficient source of artificial daylight that has ever been developed. It opens new possibilities in the use of artificial daylight since its high efficiency and coolness make it possible to illuminate large areas to high level without the use of excessive wattage or the generation of excessive heat.

In connection with the use of daylight fluorescent lamps, questions frequently arise regarding the similarity of the light produced by these lamps to actual daylight. In answering this question it is always necessary to point out that actual daylight from the sun and sky is subject to wide daily and seasonal variations, and it is therefore impossible to produce a single light source which will match more than one particular color of daylight. Daylight fluorescent lamps are designed to produce light having a color temperature of 6500° Kelvin which is generally accepted as the average color of natural daylight.

The Daylight Fluorescent Lamp is not an absolutely perfect match for light of this color, although the differences are much less than the variations in the color of actual daylight within a single day or even within a single hour.

The suitability of these lamps for any particular color matching operation depends upon a number of factors such as the nature of the colors to be matched, the degree of exactness required, the method of applying the lamps, as well as psychological factors, such as the color sensitivity and color preferences of the individual or individuals who use the light.

In view of all the above facts it is always wise to recommend that a small experimental installation be made in order to determine the suitability of the lamps before proceeding with a large installation for color matching.

Efficiency

The high efficiency of the fluorescent lamps has been the one feature which has attracted the greatest attention. It is natural that they should be compared with the familiar incandescent lamp in this respect, but much confusion and misunderstanding has resulted from such comparison which failed to make clear all of the factors involved. Such comparisons should be made on the basis of the light output of a lamp in terms of lumens and the input in terms of watts. The lumen is a unit for measuring the total quality of light produced by a light source. The 48 inch white fluorescent lamp, for example, produces 2100 lumens. The lamp consumes 40 watts plus the losses in the auxiliary equipment. These losses vary for different types of auxiliaries but only in rare instances will they be over 10 watts. We can, therefore, take 50 watts as a liberal figure for the total wattage of the 40 watt lamp and auxiliary. Dividing 2100 by 50 will give 42 as the number of lumens produced by each watt consumed. If we wish to compare this with the efficiency of an incandescent lamp of comparable wattage, we find that the standard 50 watt incandescent lamp has an efficiency of 13.2 lumens per watt. The fluorescent lamp is $42/13.2 = 3.2$ times as efficient.

If we wish to compare it with a lamp of comparable light output we might select either the 150 watt lamp with a light output of 2600 lumens and an efficiency of 17.3 lumens per watt and say that it was 2.4 times as efficient, or we might select a 100 watt lamp with a light output of 1600 lumens and an efficiency of 16.2 lumens per watt and say that it was 2.6 times as efficient.

In comparing the efficiency of the daylight fluorescent lamp with incandescent lamps using daylight blue bulbs or globes to filter the light, it should be kept in mind that these filters absorb a large percentage of the light so this efficiency is quite low. A 150 watt daylight incandescent lamp, for example, produces 1700 lumens or about 11.3 lumens per watt, whereas the 40 watt daylight fluorescent lamp produces about 36 lumens per watt and is thus about 3 times as efficient in this particular instance.

Auxiliary Equipment

Like all light sources employing an electrical discharge through a gas or vapor, fluorescent lamps must be burned in conjunction with specially designed auxiliary equipment. This auxiliary equipment consists of a current limiting device or ballast and a starter. The ballast consists of a small inductance or choke coil designed to limit the current taken by the lamp to the proper value. The purpose of the starter is to act as a time delay switch which will connect the two electrodes of the lamp in series with the ballast during a short preheating period when the lamp is first turned on and then open the circuit in order that the arc may be established. This preheating of the electrodes causes the emission of electrons and thus makes it possible to strike the arc without the use of an excessively high voltage. After the establishment of the arc the lamp continues to burn in series with the ballast which limits the current to the proper operating value.

Power Factor

When the fluorescent lamps were first introduced the available equipment was all of the single lamp type and the power factor of fluorescent lamp circuits was about 60 per cent. This meant that the current flowing in the wires used to supply these lamps was much greater than the wattage would indicate and led to considerable discussion of various means of bringing about power factor correction. The outstanding result has been the development of the two-lamp ballast.

The two-lamp ballast actually includes two separate choke coils—one having a condenser connected in series

with it to accomplish the desired power factor correction. This is possible because of the fact that a condenser produces what is known as a "leading" power factor which offsets the lagging power factor of the inductive choke coils and produces an overall power factor of better than 90 per cent for the two fluorescent lamps.

Where two-lamp ballast cannot be used or where it is desired to correct the power factor of an existing installation employing single lamp ballasts, separate condensers may be connected in the circuit. Condensers for correcting the power factor of a single lamp or larger units for correcting the power factor of several lamps are available. It is most desirable to have the power factor corrected at each individual reflector and the two-lamp ballast provides the ideal method of accomplishing this since it also minimizes the stroboscopic or flicker effect which might otherwise prove objectionable under certain circumstances.

Stroboscopic Effect

The light produced by a fluorescent lamp operating on a standard 60 cycle alternating current circuit passes from a maximum to a minimum value 120 times in each second. While this variation is too rapid to be noticed by the eye, it may give rise to what is known as a stroboscopic effect under certain conditions. Moving parts of machinery illumination by this light, for example, may appear to be moving in jerks and rotating parts may appear to be rotating much more slowly than their actual speed or even appear to be going in the reverse direction. This was never a very serious problem in the textile industry since most of the machinery is semi-automatic and requires attention only when it is not running.

If two-lamp ballasts are used the light from one lamp is at a maximum when that from the other is at a minimum, so that this effect is to a very large extent eliminated. Stroboscopic effect and power factor are thus no longer a cause for concern in considering the application of fluorescent lamps, since they are both satisfactorily corrected through the use of the two-lamp control unit.

Reflecting Equipment

A popular type of reflector for use in textile mill illumination is illustrated in Fig. 1. These reflectors employ two

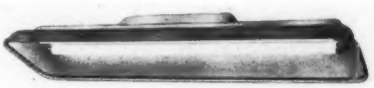


Fig. 1. This popular unit for general illumination in textile mills employs two 40 Watt 48-inch Fluorescent Lamps in a porcelain enamel reflector.

40 watt lamps provided with two-lamp control units in order to correct power factor and stroboscopic effect. The reflecting surface is of porcelain enamel which is efficient, durable, and easy to keep clean.

These units may be spaced uniformly to produce a uniform level of general illumination, or they may be arranged to conform to the spacing of the machinery in order to provide the higher levels of illumination at the more important work areas.

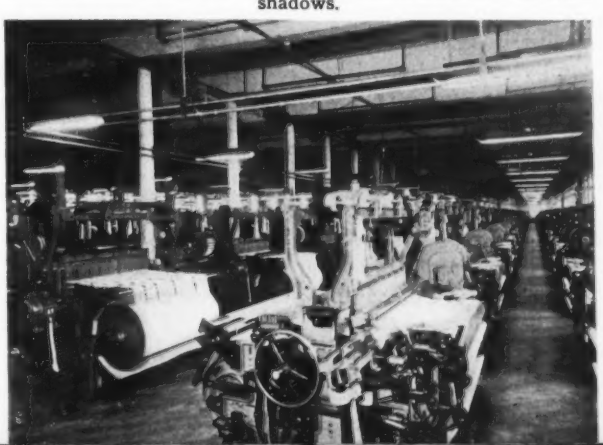
Fig. 2. Two lamp fluorescent units arranged to conform to the spacing of the machines are used to provide a high level of illumination on the important work areas in this textile mill.

For local lighting of small areas local lighting units employing either Alzak aluminum or porcelain enameled reflectors are available.

Cost of Fluorescent Lighting

Ever since the introduction of the fluorescent lamp there has been a constant demand for information regarding the comparative cost of fluorescent and incandescent lighting. The factors which enter into the cost of lighting vary so widely in different localities and in different organizations that it is impossible to give a general answer to this question. It might be pointed out, however, that the combined action of a number of factors have brought about some very significant reductions in the cost of fluorescent lighting within the past few months. These factors include increases in the life and lumen output of the lamps as well as reductions in the prices of the lamps, control units, and reflecting equipment. Cost comparisons between the two sources are usually based on an equal level of illumination from the two sources. It should be emphasized, however, that the lighting results cannot be regarded as "equivalent" on any other basis. In fact, most of the applications of fluorescent lamps have been made because of a desire to obtain the advantages of this type of lighting rather than as a more economical method of duplicating incandescent lighting. Now that the cost has become more attractive, however, the advantages of fluorescent lighting are being extended to numerous applications where it was previously not felt that they could be justified because of their cost.

Fig. 3. The illumination in this weave room is accomplished by means of two lamp fluorescent units which provide well diffused illumination free from objectionable glare and annoying shadows.



MEETING, SOUTH CENTRAL SECTION

THE Winter meeting of the South Central Section was held at the Read House, in Chattanooga, Tenn., on Saturday evening, February 8, 1941, with eighty-five members and guests in attendance. Scott Althouse of the Althouse Chemical Co. gave a paper on, "Dyes: How They Are Made," and with a portable laboratory set demonstrated the manufacture of two commonly known dyestuffs. Paul Logue of the Phosphate Technical Division of Monsanto Chemical Co. spoke on "Uses of Phosphates in the Textile Industry," with special emphasis on tetra-sodium pyrophosphate. With slides Mr. Logue explained the various reactions of phosphates, and compared them with other alkalies.

Nestor Grotelueschen and W. S. McNab were appointed as a Program Committee for the next meeting, to be held in Knoxville about the first of May.

Respectfully submitted, FRANK F. MYERS, *Secretary.*

MEMBERSHIP APPLICATIONS

Associate

Hyman Stein—Engineer and Purchasing Agent, Suffolk Knitting Co., Bennington, Vt.

Robert M. True—Technical Representative, General Dyestuff Corp., Portland, Oregon. Sponsor: C. Z. Draves.

John B. Tuttle—Sales Engineer, Standard Oil Co. of N. J., New York, N. Y.

Student

Nelson B. Armitage—New Bedford Textile School. Sponsor: F. E. Busby.

Carl D. Sickerott—N. C. State College. Sponsor: A. H. Grimshaw.

Morton Schlesinger—Lowell Textile Institute. Sponsor: L. A. Olney.

Corporate

Continental Mills, Inc.—Philadelphia, Pa.

Transfer application—John F. Kirk.

TECHNOLOGISTS NEEDED BY THE GOVERNMENT

THE U. S. Civil Service Commission has announced an open competitive examination to secure Technologists for National Defense work. Difficulty is being experienced in filling positions in such branches of technology as explosives, fuels, plastics, rubber, minerals, and textiles. Persons qualified in these branches are particularly urged to file application. Applications will be rated as received until December 31, 1941.

The duties of the positions include the planning, conducting, and reporting of investigation or research in some specialized branch of technology such as explosives, fuels, plastics, rubber, minerals, and textiles; or the testing, designing, or manufacturing of the materials essential for the successful operation of an industrial plant where such plant operation is based on some specialized branch of technology. Applicants must have completed a 4-year college course with specialized major study except that they may substitute, year for year, for the required education, professional experience in the appropriate fields of science, engineering, or technology. In addition, applicants must have had a certain number of years of professional experience in appropriate fields, the number of years varying with the grade of technologist; graduate study in an appropriate field may be substituted for a part of this experience.

The positions to be filled are in several grades with salaries ranging from $2,600 to $5,600 a year. Competitors will not be given a written test but will be rated upon their education and experience.

Further information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the United States Civil Service Commission, Washington, D. C.

MEETING, NORTHERN NEW ENGLAND SECTION

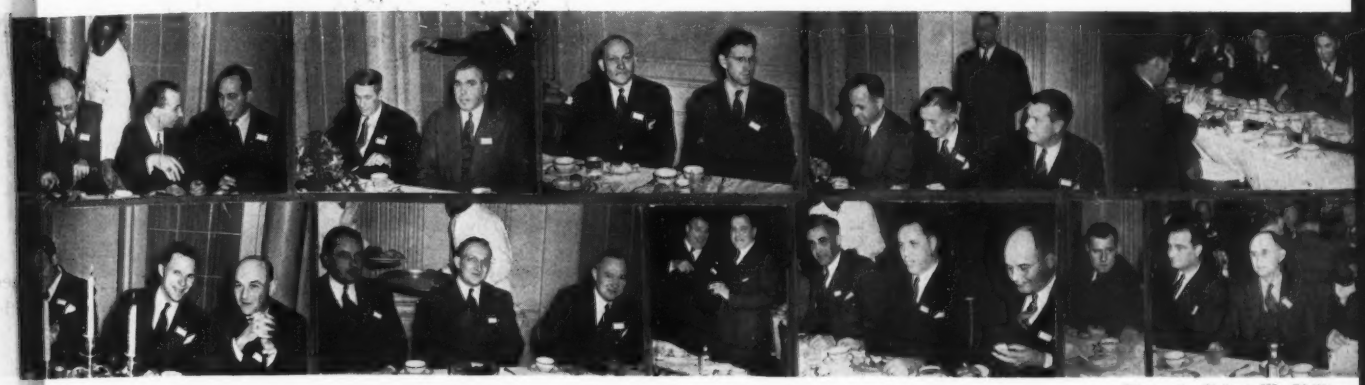
THE December meeting of the Northern New England Section was devoted to the discussion of the paper concerning cation active compounds, which was awarded the first prize in the Intersectional Contest at the Annual Meeting in New York. In the limited period at New York there was no opportunity to discuss this important subject.

Past-President William H. Cady, of the Rhode Island Section, opened the technical session in Boston by reading the paper which he had also presented in New York, entitled, "The Effect of Modern Finishing Agents on the Light Fastness of Cotton Colors." Dr. Robert E. Rose, Director of the Technical Laboratory of the duPont Company, also a Past-President of the Association, who had expected to be present, sent a communication in discussion of Mr. Cady's paper, which was read by Kenneth H. Barnard, Vice-Chairman of the Section. R. A. Ackley, a Mellon Institute Fellow for the Onyx Oil & Chemical Company, attended the meeting and made extensive and interesting comments regarding the material presented by Mr. Cady. Christian F. Klebsattel, of the Röhm & Haas Company, and others, also contributed to the discussion.

Another feature of the evening was the reading, by Henry Grimes, of the paper presented by the Northern New England Section in the Intersectional Contest in New York, entitled, "What Is New in New England." Mr. Grimes was assisted by Mr. Bell and Mr. Derby in the showing of colored slides of the Northern New England Section exhibits at the National Convention.

The meeting was held at the University Club, Boston, Massachusetts, on Friday evening, December 20, 1940. There were eighty-two members present at the dinner, and about one-hundred attended the business meeting and technical program which followed.

Respectfully submitted, EDWARD S. CHAPIN, *Secretary.*



Photos by Robert W. Philip

Snapped at the January meeting of the Piedmont Section

MEETING, PIEDMONT SECTION

THE Piedmont Section met at the King Cotton Hotel, Greensboro, North Carolina, January 25, 1941, with approximately 175 members present.

The afternoon technical session convened at 3:30 P. M. George A. Urlaub, Throwster's Research Institute, read a paper on the subject of "Yarn Preparation and Its Relation to Dyeing and Finishing." Paul W. Booher of the Owens-Corning Fiberglas Corporation presented a slide film illustrating the uses of Fiberglas. Discussion of the subjects followed with the speakers answering many questions.

Hugh M. Comer, Executive Vice-President, Avondale Mills, addressed the banquet session held at 7:30 P. M. Mr. Comer discussed his impressions of South America which he recently visited extensively. The members passed a resolution directing the secretary to write a letter to William A. Wolhar, Rosemary Manufacturing Company, thanking him for the valuable work done in behalf of the Piedmont Section, in presenting the subject of Screen Printing before the National meeting in New York.

Respectfully submitted,

D. STEWART QUERN, *Secretary.*

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

● ***Complete personal histories and employment records of the following applicants are on file at the office of the American Dyestuff Reporter.*** ●

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-1

Education—Graduate textile chemistry and dyeing course, Lowell Textile Institute, 1932. Special course in colloid chemistry at M.I.T.

Experience—Library work in spare time while attending school; five years as assistant chemist with knitting mill, duties consisting of testing and grading silk, testing of oils, soaps, dyes, finishes and other chemicals, making up specifications for various lines of hosiery and checking finished product, keeping a check on production costs, control of waste and irregulars, checking competing products and carrying on research to improve product and reduce costs. Woman; age 30; references.

A-B-8

Education—Graduate Chemist.

Experience—Print superintendent, colorist; eleven years' experience in all types of fabrics, specializing on rayon; 8 years' dyestuff laboratory and demonstrating. Excellent references; age 37; married.

A-B-9

Education—Textile School Graduate.

Experience—Executive and sales type of textile chemist and colorist desires position in sales, contact, promotional or supervisory work. Factory, laboratory, office and purchasing experience. Good correspondent. Good personality. Accustomed to assuming responsibility and exercising initiative. 21 years' experience in the textile, chemical and dye industries. Opportunity most important.

Age 43; American; married.

A-B-10

Education—1 year of textile chemistry, day course, Philadelphia Textile School; also business course.

Experience—3 years as apprentice in weaving mill in Germany, office and stock room, general clerical work, practice in all departments of cotton manufacture, dyeing, bleaching and finishing of cotton-rayon mixtures, piece and package processing; several mos. in laboratory of German dyestuff manufacturer, dyestuffs and assistants and their application, vat and naphthol dyeing.

Age 20; will go anywhere in U. S.

A-B-11

Education: Graduate chemist. Correspond and converse German, some French.

Experience: 3 years dyer; 4 years dyestuff testing, trouble-shooting, purchasing; 4 years demonstrating, consulting, and

supervising for large dyestuff manufacturer. Thoroughly experienced on rayon, cotton, silk, acetates, printing, vats. Fullest references as to character and ability. Seeks position as technician, consultant, or superintendent with reliable dyestuff sales organization or dyehouse. Age 33, married.

A-B-12

Education—Philadelphia Textile School (Evening), Chemistry and Dyeing, Quantitative and Qualitative Analysis.

Experience—Two years in yarn office, making wool stock blends. Last 6 years in dyehouse, 4 years as kettle hand, 2 years in piece dye work. Worked on yarn, raw stock and piece goods; has been dyer on union piece goods, cotton, rayon and wool, leaving wool white; also worked on all wool fabrics and woolen cross dyes; also considerable laboratory experience doing laboratory dyeings and extraction work. Seeks position as dyer or laboratory technician. Age 30; married; references.

A-B-13

Education—B.S., Chemical Engineering, Oregon State College, 1926.

Experience—First experience in dry cleaning plant; few months as sampling and control chemist with potash and chemical company; two years in dry cleaning plant, all phases of work; few months on routine and special analyses, plant problems, special studies and research for gas and electric company; 10 years teaching experience on textile chemistry, dyeing and textile testing covering all general and special courses in this field; consultant work with various mills. Seeks position in textile chemistry or dyeing.

Age 37; married; will go anywhere; references.

A-B-14

Education—Graduate of New Bedford Textile School, chemistry and dyeing course.

Experience—Two years in dyeing filament rayon skeins; seven years general laboratory work in large print works; four years overseer of package dyeing of cotton and spun rayon with all types of colors. Plant liquidating; must find other employment

Age 34; married; references.

A-B-15

Education—Graduate chemistry, dyeing and finishing course, New Bedford Textile School, 1940.

Experience—None. Seeks position in dyeing or finishing departments or in testing (chemical, physical, microscopical).

Age 27; single; references.

A-B-C-4

Education—Educated abroad.

Experience—Twenty years experience in the textile field as bleacher, dyer, finisher and chemist. 16 years in charge of dyestuff laboratory of large dyeing plant, 4 years as chief chemist with large bleachery. Has tested dyestuffs, and chemicals used in the textile field and has manufactured soaps and textile specialties. Has handled all textile fibers; bleaching, printing, dyeing and finishing same. Has done pigment and lacquer printing, waterproofing and fireproofing. Reason for leaving last position was due to business conditions. Age 41; married.

A-B-C-9

Education—Lowell Textile Institute; chemistry, dyeing and textile finishing.

Experience—Twelve years head dyer in hosiery mills. Dyeing all types of fibers and in combination. Knowledge of all dye applications. Matching and formula making. Charge of every department in a hosiery mill except fixing machinery. Has done jigg work on cottons and rayons. Desires position in hosiery, or in any field. Would like to work as an assistant to head dyer in a woolen or rayon mill. Age 42; married. Will go anywhere in the United States.

A-B-C-10

Education—Graduate New Bedford Textile School, 1940.

Seeks position connected with chemistry, dyeing or finishing.

A-B-C-D-1

Education—Lowell Textile Institute. Bachelor of Textile Chemistry; Lowell Textile Institute (Evenings), 2 years D. C. Electricity; 2 years A. C. Electricity.

Experience—Six years as chemist and assistant dyer with a large organization. Specialized in dyeing, finishing, bleaching and drying of woolens, worsteds, cottons, rayons and unions in the piece. Some sales experience. Desires position as chemist, dyer, finisher, bleacher or sales. Age 30; American citizen; Married.

A-B-D-2

Education—Evening courses, chemistry and dyeing, Philadelphia Textile School.

Experience—Eighteen years varied experience as dyer and chemist. Dyeing experience on cotton, wool, shoddy, raw stock, union piece goods, mohair, rayons and alpacca.

Age 37; married; references.

A-B-C-E-1

Education—3 years Chemical Engineer major in college; honor graduate Philadelphia Textile School, chemistry and dyeing course.

Experience—Ten years experience as chemist, colorist, technical director in bleaching, dyeing and finishing of cottons and rayons. Also one year's similar experience in South America. Instructor of textiles and textile chemistry in state vocational school, 2 years. Married; age 32; references; will go anywhere.

A-B-C-F-2

Education—Graduate, Lowell Textile Institute, 1908.

Experience—Over 30 years experience as chemist, color mixer and matcher, foreman printer, foreman dyer on all types of fibers and colors, and finisher. Experience installing complete dyeing and finishing departments. Experience as manager of dyeing and finishing companies. Experience in New York market: interviews with converters, obtaining orders, new customers, settling claims, etc.

Age 51; married, will go anywhere; references.

A-B-D-1

Education—Special courses in general chemistry.

Experience—Twenty-nine years' experience in application and standardization laboratories of various dyestuff manufacturers. Well versed in the application of dyestuffs to different textile fibers, i.e., wool, cotton, rayon, silk, acetate rayon and unions, using direct, acid, diazo, sulfur, acetate rayon, chrome and after-treated direct dyestuffs. Six months' actual dye house experience on jigs, open boxes, padders, bleaching and mercerizing. Experience demonstrating sulfur and direct colors at various mills. Seeks position as textile colorist in application laboratory and demonstrator. Age 46; single; references.

B-6

Education—Graduate New Bedford Textile School; also post graduate work in advanced microscopy and rayon testing.

Experience—Five weeks in color shop of print works. Wants position in anything associated with textile chemistry, dyeing, finishing and testing. Single; age 21; references.

B-7

Education—Evening course in chemistry and dyeing at Philadelphia Textile School. Evening course in chemistry at Drexel Institute.

Experience—Started as second hand in dyeworks, then two years as head dyer on women's and children's hosiery. One year as head dyer with other dye works on all types of women's hosiery including Bemberg, rayon and cotton combinations.

Age 26; married; will go anywhere in U. S.; references.

B-8

Experience—20 years' experience with printing companies. Experience as colorist on basics, chromes, Indigosols, vats, rapid fasts, naphthols, Rapidogens and Aridyes. Seeks position as colorist and shader.

Age 49; married; references.

B-9

Education—Graduate of German textile school.

Experience—Twenty-seven years' experience abroad and in this country as chemist, colorist and dyer on cotton, rayon, wool, half-wool, half-silk and silk with various types of dyes and machines. Experience as trouble shooter.

Age 43; married; references.

B-C-1

Education—Two year night course in chemistry, Rhode Island School of Design.

Experience—Nineteen years' experience in printing and finishing plants, in practically every department. Has had direct charge of color shop and practical experience in both peroxide and chemic bleach. Also has had experience as assistant superintendent and superintendent of printing and finishing cotton and rayon piece goods and as company manager in finishing plant.

Age 38; married; references.

B-D-1

Education—General education in England. Chemistry and Dyeing Courses at Huddersfield Technical School.

Experience—Has been a superintendent of dyeing since 1911. Has had experience in worsted mills, hosiery mills and woolen mills. Congenial, sober and reliable. Married; references; age 53.

OBITUARY

JOHN G. WICK

JOHN G. WICK, salesman for the Carbic Color & Chemical Co., Inc., died on February 7th at the Presbyterian Hospital, New York City. Funeral services were held at his home in Madison, N. J., on February 9th.

Mr. Wick had been a salesman for the Carbic company, covering the New York territory, since 1909. Previous to that he had been employed as a salesman for the Kali Manufacturing Co. He was an associate member of the American Association of Textile Chemists and Colorists.

He is survived by his widow and two daughters.

• HART BOOKLET

Hart Products Corp., 1440 Broadway, New York City, has recently issued a booklet entitled "Mercerizing and Dypenol" which discusses the subject generally and gives specific information concerning the use of Dypenol, a mercerizing penetrant. It is stated that to increase the penetrating properties of the caustic solution requires only the addition of a small quantity of Dypenol to the mercerizing liquor. The use of Dypenol is therefore said to make possible "Dry Mercerizing", i.e., it eliminates all preparation of the yarn such as boiling-out or wetting-out.

Advantages claimed for Dypenol are: that it is extremely easy to use; may be dissolved directly in the mercerizing caustic; does not lose its wetting power on standing; does not form a scum in the caustic; is easily washed out of the goods; has a low solvent effect on cotton waxes and pectin; has a low exhaustion rate; will not foam or cause sludge formation in caustic recovery systems.

Copies of the booklet are available upon request.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York City, has recently released circulars describing the following products:—

Viscose Navy Blue D—a direct dyestuff suitable for producing navy blue shades on cotton and, in particular, on rayon. The dyeings can be discharged to a good white with Rongalite C. It is stated that, because of its good resistance to diazotization and development with Developer ON, it is of interest for dyeing navies in conjunction with Cellitazols on mixed goods of rayon and acetate. Circular G-224.

Benzoform Yellow GG Extra—a direct color recommended for the dyeing of cotton and rayon. When aftertreated with formaldehyde and acetic acid, in the manner usual for Benzoforms, it is said to produce bright, fairly greenish yellows of comparatively good fastness to washing. It leaves both effect threads and surfaces of acetate rayon unstained, and dyes silk effects much lighter than the vegetable fiber. In union dyeings made at the boil, the wool is dyed considerably lighter and greener than the cotton, while at about 150°F the wool is stained comparatively little and can be kept white by the addition of Katanol WB Conc. to the dyebath. The addition of chrome to the formaldehyde bath has no effect; copper sulfate, on the other hand, turns the shade considerably greener and shows a slight detrimental effect on the fastness to washing and light. Circular G-225.

Indanthren Blue BD Suprafix—a special printing brand of Indanthren Blue BCSA. It is stated that it is in the form of a smooth flowing, grit-free paste which will not settle out under ordinary conditions. The product is said to fix readily, even under varying steaming conditions. It prints bright shades of sky blue said to be characterized by their good fastness to chlorine and outstanding fastness to light. It is well suited for use on curtains, awnings, and other severely exposed materials. It is said to possess good fastness to the caustic overprinting employed to produce plissee effects. Circular G-227.

• TEXTONE ON DISPLAY

One of the interesting new textile processing materials to be displayed at this year's Southern Textile Exposition is Textone, a product of The Mathieson Alkali Works. Although still in the development stage, it is stated that this new chemical has already shown ample indications of its future usefulness to the textile industry. A half-million-dollar plant for the manufacture of Textone and other sodium chlorite products is now nearing completion at Niagara Falls, N. Y., according to an announcement from the company's executive offices at 60 East 42nd Street, New York City.

The Mathieson display at Greenville will be located in Booths 469-470 in the Annex —the same space the company has occupied at previous shows over a long period of years. Other textile chemicals to be featured include liquid chlorine, caustic soda, soda ash, bicarbonate of soda, aqua ammonia and HTH. On display also will be dry ice and carbonic gas, both well-known among southern bottlers and ice cream manufacturers.

As in previous years, the Mathieson men will make their headquarters at the Poinsett Hotel. Those in attendance during the show will include Fred O. Tilson, southern district sales manager, J. R. Harrington, J. W. Ivey, R. C. Staples, M. K. Sanders, A. L. Dubeau and Z. N. Holler.

• "CARBOWAX" COMPOUNDS

"Carbowax" is the registered trade-mark for a group of solid and semi-solid, water-soluble compounds, recently released by the Carbide and Carbon Chemicals Corps., 30 East 42nd St., New York, N. Y. Two grades now commercially available are known as "Carbowax" 1,500 and "Carbowax" 4,000.

Applications of the "Carbowax" products already developed or experimentally used in the textile industry are their use in bleach baths to improve "handle" of goods; in warp sizes, conditioners and finishing agents for cotton yarns; as a dispersant for certain water-insoluble dyes; in weighting felts; and as a binder and filler in water crayon suitable for making easily removable, temporary markings on textiles.

"Carbowax" compound is used as a yarn lubricant and sizing material on account of its body, water-solubility and softening effect. It is stated that no more than one or two per cent need be added to the bleach bath for improving cotton textiles. Since it need be added but once directly to the bleach bath, its use is said to be economical from the standpoint of time and material.

As is well known to those in the industry, buyers of felts used in automotive, shoe and slipper applications often expect a slight overage in the weights of material they purchase. Felts coming too close to specification can be weighted by running the felts through an aqueous solution of "Carbowax" compound. In the case of felts used in shoes and slippers, "Carbowax" 4,000, which is relatively hard, has a tendency to flake off during the lastings, but a mixture of "Carbowax" 1,500 and 4,000 is said to overcome this.

An application that shows promise is the addition of "Carbowax" compound 4,000 to water-insoluble dyes to increase the dispensibility of the dye in water.

Unlike "self-emulsifying" waxes, the "Carbowax" products are said to be completely soluble in water to form solutions that are transparent as water itself. Aqueous solutions of various viscosities can be prepared by varying the concentration. For example, solutions containing 10 to 20 per cent of "Carbowax" 4,000 are similar to glycerine in viscosity, while at higher concentrations thick syrupy solutions are obtained. The "Carbowax" compounds are also said to be suitable for many mutual solvent applications because they are soluble in aromatic hydrocarbons

Physical Properties and Solubility Data of "Carbowax" Compounds

Physical Properties

	Density g. per cc. at 20° C.	*Melting Point, °C.*	*Viscosity Saybolt Universal sec. at 210° F.*	*Flash Point °F.*
"Carbowax" 1500	1.152	35 to 37	78	430
"Carbowax" 4000	1.203	50 to 53	418	535

Solubility Data

	"Carbowax" 1500 g. per 100 cc. at		*"Carbowax" 4000 g. per 100 cc. at*	
	20° C.	*50° C.*	*20° C.*	*50° C.*
Acetone	>100	complete	>100	>100
"Cellosolve"* Solvent	>100	complete	40	>100
Ethanol	>100	complete	33	>100
Ethyl Acetate	>100	complete	43	>100
Heptane	<0.01% by weight	<0.01% by weight	<0.01% by weight	<0.01% by weight
Pine Oil	20% by weight	complete (80° C.)	insoluble	<50% by weight
Toluol	>100	complete	43	>100
Water	>100	complete	>100	>100

*Trade-mark.

as well as in water. It is stated that aqueous solutions have surface-active properties that may be of value in impregnating fabrics. Since they contain no nitrogen, halogen, sulfur atoms nor ester, ketone or aldehyde groups, it is claimed that they are stable and inert either when pure or when dissolved in aqueous solutions containing acids, bases or salts.

"Carbowax" compound 1,500 is a soft solid with the consistency of petrolatum. To a slight degree it absorbs moisture from the atmosphere, but is said to be much less hygroscopic than ethylene glycol or glycerine. This is important in finishing formulas, where it is necessary to regulate the moisture pickup. "Carbowax" compound 4,000, on the other hand, is a hard, translucent solid, said to be unique in that its paraffin-like appearance and consistency is associated with the property of complete water-solubility. It differs from "Carbowax" compound 1500 in that it possesses a higher melting point and is less hygroscopic; hence it does not become moist on exposure to humid air.

It is stated that tests on humans with either "Carbowax" compound have failed to show any evidence of skin irritation on repeated application, or any appreciable skin absorption.

● PHI PSI CONVENTION

The Thirty-Eighth Annual Convention of Phi Psi Fraternity will be held in Providence, Rhode Island, May 16-17 at the Providence-Biltmore Hotel.

Featured at the convention this year will be an exhibition of textiles and allied products.

● STROBOSCOPE DISPLAY

The main feature of the General Electric Company exhibit at the Southern Textile Exposition to be held in Greenville, S. C., March 31 to April 5, will be an operating stroboscope checking color register on cloth—marking the first showing of this new application. Providing instantaneous scanning of cloth patterns regardless of the speed at which the cloth is proceeding through the printing machine, the new machine employs standard fluorescent lamps to check register in cloth printing, or discover defects in cloth or printing process. While standard commercial units will operate on patterns with up to 8 or 12 different inks, the one on display at the Exposition, for simplicity, will show only four colors.

● STEIN, HALL EXHIBIT

Stein, Hall & Company, Inc., now celebrating its 75th year of starch service, will exhibit Corn, Wheat, Potato, and Sweet Potato Starches in Booths 467 and 468 at the Southern Textile Exposition in Greenville.

Features of the exhibit will include demonstrations of the Stroboscope and Viscosimeter to illustrate the methods used by the company's laboratories in solving textile sizing, finishing, and printing problems. Stein-Hall technical service for textile mills will also be illustrated by a series of photomurals depicting types of research through which the company has developed its line of products.

Company representatives at the exposition will include: Ira L. Griffin, Southern Manager; Edwin Stein, Vice-President; Edward Butts, Sales Manager; Dave E. Truax, chemist; T. C. Davis, W. B. Strickland, and W. N. Kline, Jr., salesmen.

● NEW EASTMAN DYE

Tennessee Eastman Corporation, Kingsport, Tennessee, announces the addition of a new red dye to its series of colors claimed to be resistant to gas and light fading. The new dye, Eastone Red R, produces medium bright shades of red on cellulose acetate materials, and may be used for application printing. It is said to offer an important advantage to the user in that it dyes in level shades of substantially the same depth over a wide temperature range. It is stated that tests have shown the new dye to have superior resistance to perspiration and crocking, and to be satisfactory for washing as well as dry cleaning.

● APPOINTED TRUSTEE

Appointment of Charles P. Gulick of East Orange, N. J., president and chairman of the board of National Oil Products Company, Harrison, N. J., to the Trustee-Advisory Committee of the College of Pharmacy of Rutgers University, has recently been announced by Robert C. Clothier, president of the college.

"I feel deeply honored by this appointment," Mr. Gulick said in accepting the new post. "I am certain I will find the association a source of great personal satisfaction and sincerely trust I will be of service to Rutgers University."

Mr. Gulick is one of the pioneers in the field of chemcial research in industry and has spent the past 34 years in the chemical manufacturing business. His firm employs a staff of more than 100 technical men in its research laboratories.

● STYLE SHOW

The February issue of the National *Geographic* Magazine, in its story of "Cotton: Foremost Fiber in the World," carried two colored pictures of young ladies who took part in the 1940 Style Show at North Carolina State College. These pictures were designated as "Coeds make their own from cotton their fathers grew and their classmates wove," also "Design for Living—Tennis, street wear, housework, and evening gowns—all of cotton."

All the fabrics used were designed and woven by students in the Textile School of North Carolina State College. Other garments modeled by students in the Style Show were made from rayon, spun rayon, and mixtures of wool and spun rayon.

The 1941 Style Show will be held in Pullen Hall at State College on Thursday, April 24, when about 150 young ladies from the home economics departments of ten North Carolina colleges will model garments in which all the material used has been dyed, designed and woven by students in this school. This is one of the outstanding events of the college year and demonstrates the theoretical and practical instruction given to Textile students at State College.

• FIFTIETH ANNIVERSARY

C. Walter Kuhl, President and General Manager of the Carbic Color & Chemical Co., Inc., was honored at a dinner held at Luchow's Restaurant on 14th Street, New York City, on February 21st. The occasion was the fiftieth anniversary of Mr. Kuhl's association with the Carbic company and was attended by 50 persons.

Mr. Kuhl was presented with a silver tray inscribed with the signatures of all the members of the corporation. Henry Zeil, Sr., with the next longest record of employment with the company, 46 years, made the presentation. In accepting the tray Mr. Kuhl thanked all the members of the corporation and spoke feelingly of the cooperation and help he has received during the past 50 years and also expressed gratification regarding the long tenure of service of his associates.

After the dinner a bowling tournament was held at the Downtown Bowling Academy which was won by August Flotteron, head of the mixing department.

• U. S. S. EXHIBIT

United States Steel subsidiaries will present a joint exhibit at the Southern Textile exposition to be held in Greenville, South Carolina, on March 31 to April 5. The exhibit will be in Section 122 of Textile Hall and will present display featuring the many applications of stainless steel in the textile industries. Additional exhibit material will show the various types and applications of seamless steel tubing, mechanical tubing and other interesting pipe and tube applications. Visitors will also receive a clear picture of how the engineering design and structural fabrication facilities of United States Steel subsidiaries are being utilized in the textile industries. In addition to the display sections of the exhibit, comfortable lounge areas will be provided where visitors may rest or discuss problems at their leisure with the technical men in attendance.

Cooperating in this joint exhibit will be American Bridge Company, Carnegie-Illinois Steel Corporation, National Tube Company and Virginia Bridge Company, all subsidiaries of United States Steel Corporation. Representatives of the subsidiary companies will be on hand at all times to discuss problems and answer questions.

• MEETING, S. C. I.

A meeting of the American Section of the Society of Chemical Industry was held February 28th at the Chemists' Club, 52 East 41st Street, New York City. This was a joint meeting with the American Institute of Chemical Engineers.

The meeting took the form of a symposium on wetting agents. The first speaker was Professor F. E. Bartell, Professor of Chemistry of the University of Michigan, who presented a paper on "Theory of Wetting Agents." Wetting agents have polar and non-polar groups in the molecule. Through orientation at interfaces they bring about a decrease of the interfacial energy and thus serve to give higher adhesional forces at these interfaces. To evaluate properly a wetting agent for a given purpose one must know the energy values, and the energy changes that can be brought about, at the interface or interfaces of the system in question. Surface tension, interfacial tension and contact angle measurements are essential for the determination of energy changes which occur and which give a measure of the degree of wetting of a solid by a liquid.

C. R. Caryl of the American Cyanamid Co. spoke on "The Structure of Wetting Agent Molecules." Confining the discussion to synthetic organic compounds, comparison was made of the wetting power and other characteristics of several members from each of four homologous series, (1) the sulfated primary alcohols, (2) the sulfated secondary alcohols, (3) the alkyl benzene sulfonates, and (4) the sulfonated esters of succinic acid. Variations in polar groups and in non-polar groups cause wide differences in their properties. New data were presented for the sulfonated esters of succinic acid, on the area and length of the molecules, and their orientation at an interface as a function of time. Electron microphotographs of sulfur and bacteria treated with wetting agents were shown.

Dr. Samuel Lenher of the Organic Chemicals Department of E. I. du Pont de Nemours & Co. discussed "Uses of Wetting Agents." He reviewed the present commercial uses of wetting agents, discussed uses of penetrants where soap is replaced, mentioned newer applications of wetting agents with special comment on uses which appear to be novel, and gave a history of the development of commercial wetting agents to their present place in industry.

ADVERTISEMENT RECEIVES AWARD

This Scholler Bros., Inc., advertisement, prepared by R. E. Lovekin Corp., was selected by a committee of artists and art critics to receive one of two awards offered in the 1941 Exhibition of the Advertising Art Directors Club of Philadelphia, now being held at the Philadelphia Museum of Art, for the best laid out and designed magazine advertisement, including both general and trade publications, from among more than 300 entries.

Ballotting by over 40,000 persons who have attended this exhibition placed this photograph first among all advertising illustrations on exhibit.

• FOXBORO EXHIBIT

The central theme of the Foxboro Company's exhibit, at the Southern Textile Exposition, will be the fact that control of process variables is essential in the production of fabrics of uniform high quality and, in fact, the efficient operation of the entire plant. A large number of Foxboro instruments for the measurement of these variables will be shown, in addition to control instruments of both the pneumatic and electric-operated type. A feature of the exhibit will be a giant portfolio of photographs showing Foxboro Instrumentation in textile mills throughout the country.

One of the Foxboro instruments most widely known in the textile industry, the Relative Humidity Recording Controller, will be exhibited, while another display will show one of Foxboro's newest developments, the Pneumatic Loading Control system which, within the past year, has been put into successful operation on a number of padders, presses and other machines of the squeeze-roll type.

The Foxboro exhibit will be in Booths 426 and 427 in Annex No. 1. Those in attendance will include Messrs. Ralph Hayden, Jr., E. S. Lawson, W. W. Barron, E. G. Cullings, R. W. Allen, John Larson and G. E. Clark.

• CALCO BULLETINS

The dyes used for the eight principal olive drab uniform cloths of wool are described in Technical Bulletin No. 583, being issued by the Calco Chemical Division, American Cyanamid Company. This bulletin describes four dyes, several of which, when combined in various formulations, produce the specified shades. According to the bulletin, all of these dyes meet the rigid fastness tests specified by the Government. This bulletin also has raw stock mounts showing each of the four dyes and each of the formulations, as well as the final mixed shades. The suggested formulations are also outlined and dyeing methods are described.

A copper-free sulfur dyestuff is being

featured in another bulletin by Calco. Calcogene Green YSCF, the name of this color, offers dyers of rubberized goods two unusual advantages. It is stated that its copper-free and manganese-free characteristic, plus its excellent resistance to wet finishing operations, makes this dye useful to dyers and finishers of rayon-fiber wool blends. Calcogene Green YSCF is a so-called non-oxidizing green and for that reason is said to work especially well as a component in compound shades for dyeing cotton or rayon in the various types of dyeing machines.

Copies of these bulletins can be obtained on request to Calco at Bound Brook, N. J.

• ADDRESS TEXTILE STUDENTS

During recent weeks prominent men in the textile industry have addressed students of North Carolina State College on various subjects. The first speaker was P. J. Wood, former president of the American Association of Chemists and Colorists, who spoke on the subject of penetrants, water soluble resins and textile finishes. He was followed by Sydney Edelstein, former research associate for the Association, whose subject was mercerizing of yarns and fabrics.

Norman Sixt, chief chemist, and C. Wheeler, salesman of the Carolina Aniline & Extract Company, gave talks on the soaping of silk and rayon.

Another speaker was Henry Latham of the class of 1936, who gave a very interesting talk on compounds used in textile finishing.

Plans have been made to have other prominent speakers address the students in other phases of the textile industry.

• BROWN EXHIBIT

At Booths 420-21-22, Southern Textile Exhibition, the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., will feature indicating, recording and control instruments for the regulation of temperature, pressure, flow, humidity, liquid level, etc., in textile processes.

Featured in this exhibit is a working demonstration of slasher speed control. A photographic model of the slashing machine is equipped with the Brown Moist-o-Graph Recording Controller.

COMMUNICATION

Re: Depreciation and Appraisals

Editor, AMERICAN DYESTUFF REPORTER

Dear Sir:—

I have read with interest the editorial appearing in the January issue of your publication entitled "Depreciation Needs Checking." As the analysis, measurement and control of property depreciation is a major part of our activity as a professional valuation service organization, I am sure you appreciate my interest in any published expressions or thoughts on the subject.

The points brought out in this article are well taken, and agree generally with our thoughts and practice. There are, however, a few very broad and possibly confusing statements made, which might prove a handicap to a property owner attempting to solve a depreciation problem in his own business.

One of these statements occurs in the first sentence of the first paragraph on page 18. Actually, this statement is both correct and incorrect, depending upon the interpretation of the word "appraisal." If an appraisal, based upon current reproduction cost less depreciation, is meant, the statement is correct. However, if an appraisal to determine the "allowable" annual depreciation provision under present income tax regulations is meant, it is incorrect.

The word "appraisal" is of course a very relative term and will generally create confusion unless identified as to type.

As it happens, we are rendering extensive service for income tax requirements, the results of which are being accepted by the Revenue Bureau of the Treasury Department. We have made an intensive study of this subject in this connection, and have probably made more investigations for this requirement than any other organization of this kind in this country.

I also note with interest your reference to the difficulties caused by the use of depreciation formulaes. As you interpret this term, I would say that you had emphasized the major stumbling block of this whole subject. The use of average or composite rates of depreciation applied against any property account, presupposes the existence in that account of assets with varying lives. A depreciation policy which is based upon the selection of any theoretical average rate can, obviously, be only generally correct and will ultimately permit the existence of a theoretical accounting record. This condition has not only created serious insolvencies over the past decade, but is causing inequitable and costly income tax assessments today. There is, of course, no objection to the use of average rates where properly applied, but this can be only done through the use of weighted average rates.

The correct projection of expected useful life of any depreciable item in any business is also obviously impossible. Many variable factors exist in every business which affect differently the physical and functional utility of any group of even similar assets. Recognition of this condition is evidenced by present income tax restrictions on property abandonment loss claims.

There are, of course, many theories and methods of depreciation, which may be effective in a special depreciation problem, but which create conflicting results generally. The result frequently is complication, rather than practical simplification of the depreciation problem in its entirety.

The most practical approach to the entire subject is one based upon fundamentals. In other words, a property account should represent the actual property facts correctly, the same as any other accounting record is designed to do. To accomplish this, individual control of the asset cost, the depreciation reserve computed in accordance with the condition and utility of the asset, as of a basic date, and the resultant determination of the individual undepreciated balance must be established in accordance with an inventory of the capitalized assets in use. To retire the respective balances so determined, item life expectancies must be established, from which the annual provision can be readily computed.

While there is general agreement on the accuracy of this method, it is surprising, however, to observe its limited adoption, even by manufacturing companies where the

property accounts are usually the largest of any on the balance sheet. Resistance to the adoption of adequate property accounting is usually caused by a misconception of the initial cost of establishment of the necessary records and their proper maintenance. Experience has definitely established that in spite of the relative size of the property account, the operating cost of maintaining an item control, as above indicated, is fractionally less than that incident to any other asset account with the possible exception of a security investment account, where one exists.

In addition to the accuracy, provability and flexibility of item property control, there exists today an administrative advantage in connection with income taxes which, in the majority of instances, provides ample incentive. This condition is generally due to a mathematical technicality in average rate computation.

The emphasis placed by your editorial on this subject is both timely and particularly important to the chemical industry. Exceptionally fast development has taken place in it, which has resulted in high obsolescence charges. In addition, the recent large increase in production, due to the Defense Program, has made the industry exceptionally vulnerable to excess profits taxes, it being one of the so-called growth industries.

Yours very truly,

W. M. YOUNG, *Regional Executive,*

THE AMERICAN APPRAISAL COMPANY, INC.,

1 Cedar St., New York, N. Y.

—— ♦ ♦ ——

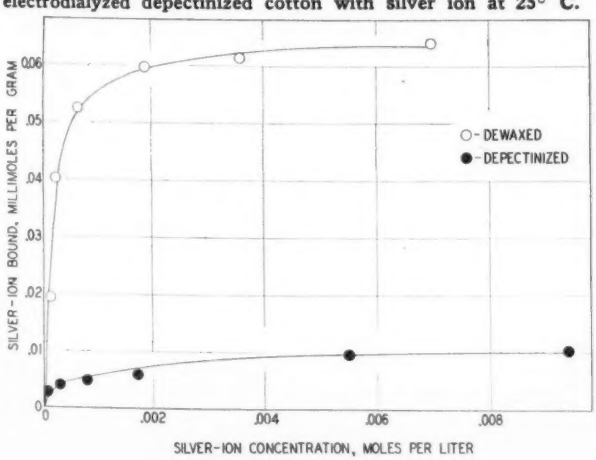
Cotton—

(Continued from page 108)

conform approximately to the mass-action law, as would be expected.

Table 1 gives the results of measurements of the silver-binding capacity of the different samples of cotton which were immersed in 0.01 *M* solutions of silver nitrate, silver acetate, and silver *o*-nitrophenolate. Each of the results represents the mean of two determinations which agreed within 0.001 M.-eq./g.

Figure 1. Combination of electrodialyzed dewaxed and of electrodialyzed depectinized cotton with silver ion at 25° C.



In accord with the above discussion, it was found that the silver-binding capacities of electrodialyzed dewaxed and electrodialyzed depectinized cotton increased as the hydrogen ion concentration of the solution in equilibrium with the samples decreased. When silver *o*-nitrophenolate was used, the final pH was above 7 and accordingly, the competition offered by the hydrogen ions is practically negligible. Thus, the values of 0.066 and 0.011 M.-eq./g. obtained by titrating electrodialyzed dewaxed and electrodialyzed depectinized cottons, respectively, with this salt may be considered to be the base-binding capacities of these materials. The values obtained with this salt are in excellent agreement with the earlier estimates of the content of acidic groups[2].

The data also show that when the cotton samples are not freed of their cationic ash by electrodialysis, the maximum silver-binding capacity is not attained under the conditions of these experiments, even though the pH of the equilibrium solution may be above 7. This may be explained as resulting from competition between silver

TABLE 1
Silver-Binding Capacity of Samples Soaked in 0.01 *M* Solutions of Various Silver Salts

Sample	*Solution*	*Silver Bound M.-eq./g.*	*Equilibrium pH*
Electrodialyzed dewaxed cotton	silver nitrate	0.021	3.22
Electrodialyzed dewaxed cotton	silver acetate	.047	4.14
Electrodialyzed dewaxed cotton	silver *o*-nitrophenolate	.066	7.12
Dewaxed cotton	silver nitrate	.036	5.12
Dewaxed cotton	silver acetate	.035	6.26
Dewaxed cotton	silver *o*-nitrophenolate	.046	7.60
Electrodialyzed depectinized cotton	silver *o*-nitrophenolate	.011	7.64
Lime-washed depectinized cotton	silver *o*-nitrophenolate	.009	7.64

ions and cations already on the fiber as shown in eq. 2. It should be noted that according to this equation silver ions of the solution are exchanged with cations such as calcium, rather than with hydrogen ions. The result of this exchange should be a smaller decrease of the initial pH values of the solutions. The data of Table 1 show that the pH values of corresponding solutions are indeed higher for the samples that were not electrodialyzed, and as a result, competition of hydrogen ions for the acidic groups is lowered. Thus, when silver nitrate solutions are used, the hydrogen ion concentration of the solution in equilibrium with the dewaxed cotton is considerably lower than that of a similar solution in equilibrium with the electrodialyzed dewaxed cotton, and a corresponding difference in silver-binding capacities is observed.

2. Combination with Calcium Ions

It has been shown elsewhere[4] that an estimate can be made of the number of acidic groups of cotton by engaging these groups with tightly held cations such as calcium, followed by electrodialytic determination of the cation content of the sample. In the present investigation, samples of electrodialyzed dewaxed and electrodialyzed depectin-

ized cotton were treated for 2 hours with a large excess of a 0.01 *M* solution of calcium acetate and then washed in running distilled water for an additional 2 hours in order to remove unreacted calcium acetate. Determination of the cation contents showed that the electrodialyzed dewaxed sample bound 0.064 and the electrodialyzed depectinized, 0.010 M-eq/g. of calcium ion. Both values agree well with those obtained by titration with silver *o*-nitrophenolate as well as with the earlier estimates from the acid-binding determinations[2].

3. The Acidic Groups in Depectinized Cotton

Since the same number of equivalents of calcium, silver, and hydrogen ions are bound by depectinized cotton, it may be concluded that both valences of the calcium are satisfied by the acidic groups of the fiber. This is of considerable significance inasmuch as it strongly indicates that the phenomenon being investigated is an acid-base equilibrium and not some indefinite adsorption process. Further evidence favoring this view has resulted from another type of experiment.

When electrodialyzed depectinized fibers* were treated for a short time with a solution of diazomethane in ether and then washed with a solution of calcium acetate, it was found that they bound less than 0.001 M-eq/g. of calcium. In other words, the acidic groups appear to be readily esterified by treatment with diazomethane, and are no longer available for reaction with base.

It was suggested earlier[2] that the acidic groups in depectinized cotton might well be a part of the cellulose molecule, especially since the experimental evidence did not favor the alternative possibilities that the groups might be present as the result of incomplete removal of the pectic substance or of the protein fraction during purification treatments. Assuming this to be true, the question still arises as to whether these groups were in the original cellulose or whether they were produced during the purification treatment of the fiber with alkali. In favor of the former possibility are the following experimental results. Dewaxed cotton contains 0.065 M-eq/g. of acidic groups. The pectic substance of the cotton contributes 0.055 M-eq/g. as shown by direct uronic acid determinations[8]. The difference, 0.010 M-eq/g, is exactly equal to the number of acidic groups found in the depectinized cotton.

It is conceivable, of course, that the acidic groups, other than those of the pectic substance, are in substances which are removed during purification of the fiber, and that the acidic groups found were formed by oxidation of the cellulose during treatment with alkali†. This would necessitate the formation of 0.010 M-eq/g. of acidic groups, the same number as would be removed during the purification treatment. Such a coincidence appears to be rather unlikely. However, if it is assumed that such a reaction does take place and proceeds slowly, then it would be expected that the content of acidic groups would steadily increase during the treatment of the fiber with alkali. Such changes would be detectable by methods described in the present paper. If the reaction proceeds extremely rapidly so that it might go to completion even before complete removal of the pectic substance, the question whether the acidic groups in depectinized fibers are in the naturally occurring fiber or are produced during purification treatment cannot be answered at this time. Nevertheless, it appeared advisable to measure the base-binding capacity of samples purified for different lengths of time by extraction with a boiling 1 per cent solution of sodium hydroxide. The results are shown in Table 2, and clearly indicate that no significant progressive changes in the acidic properties of the fiber have been produced, even after 16 hours of treatment with alkali. Thus, the possibility of slow formation of these acidic groups during the depectinizing treatments is also eliminated.

TABLE 2
Cation-Binding Capacity of Cotton Samples as a Function of Duration of Depectinizing Treatment

Duration of Alkali Treatment Hr.	*Silver Bound M-eq./g.*	*Calcium Bound M-eq./g.*
2	0.010	0.011
4	.010	.009
8	.011	.009
16	.011	.010

*It is necessary to use fibers that are essentially ash-free, since the presence of cations on the acidic groups prevents their reaction with diazomethane.

†While precautions are taken to keep oxygen from the system, it is not possible under these conditions to rigorously exclude it.

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